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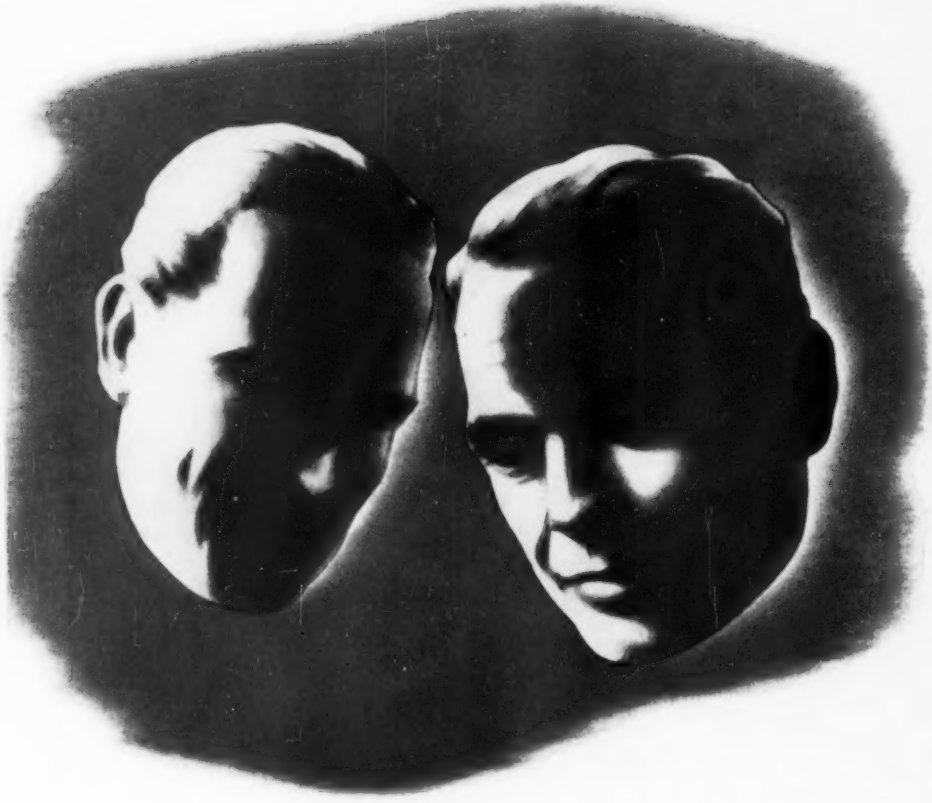

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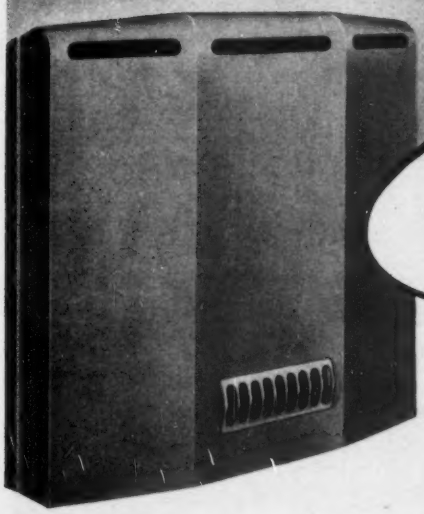

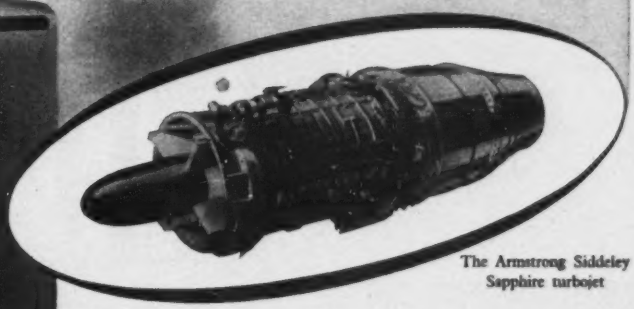

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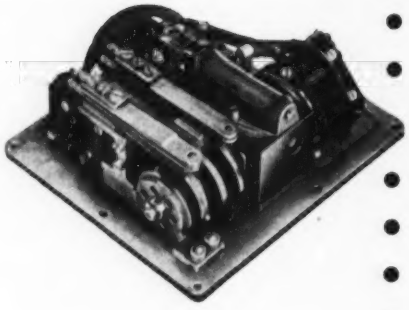

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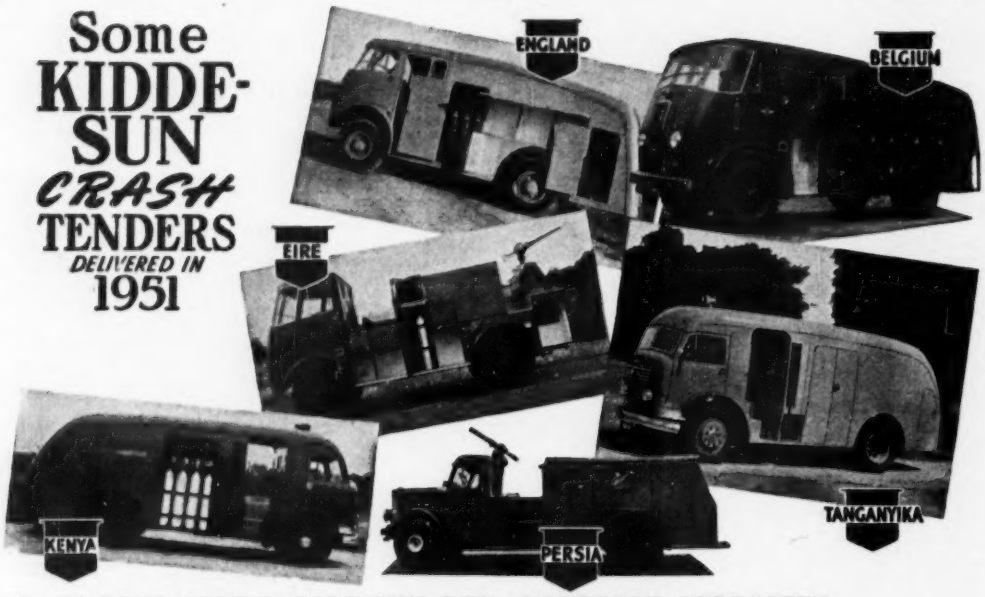

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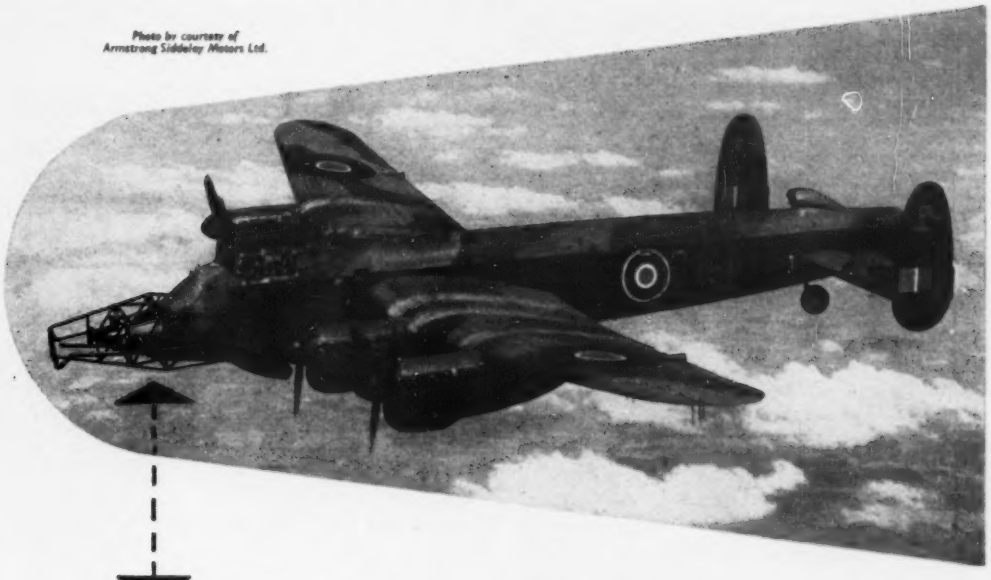

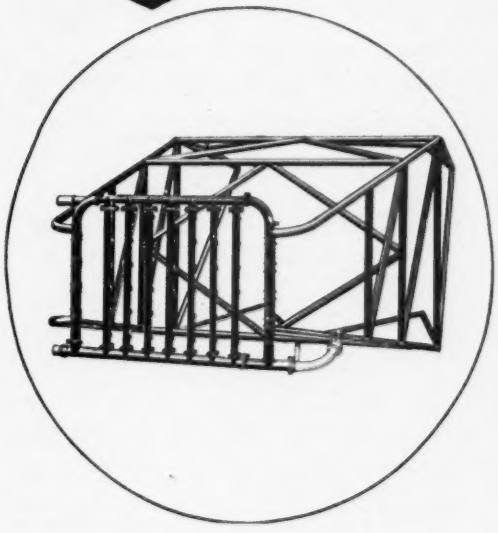

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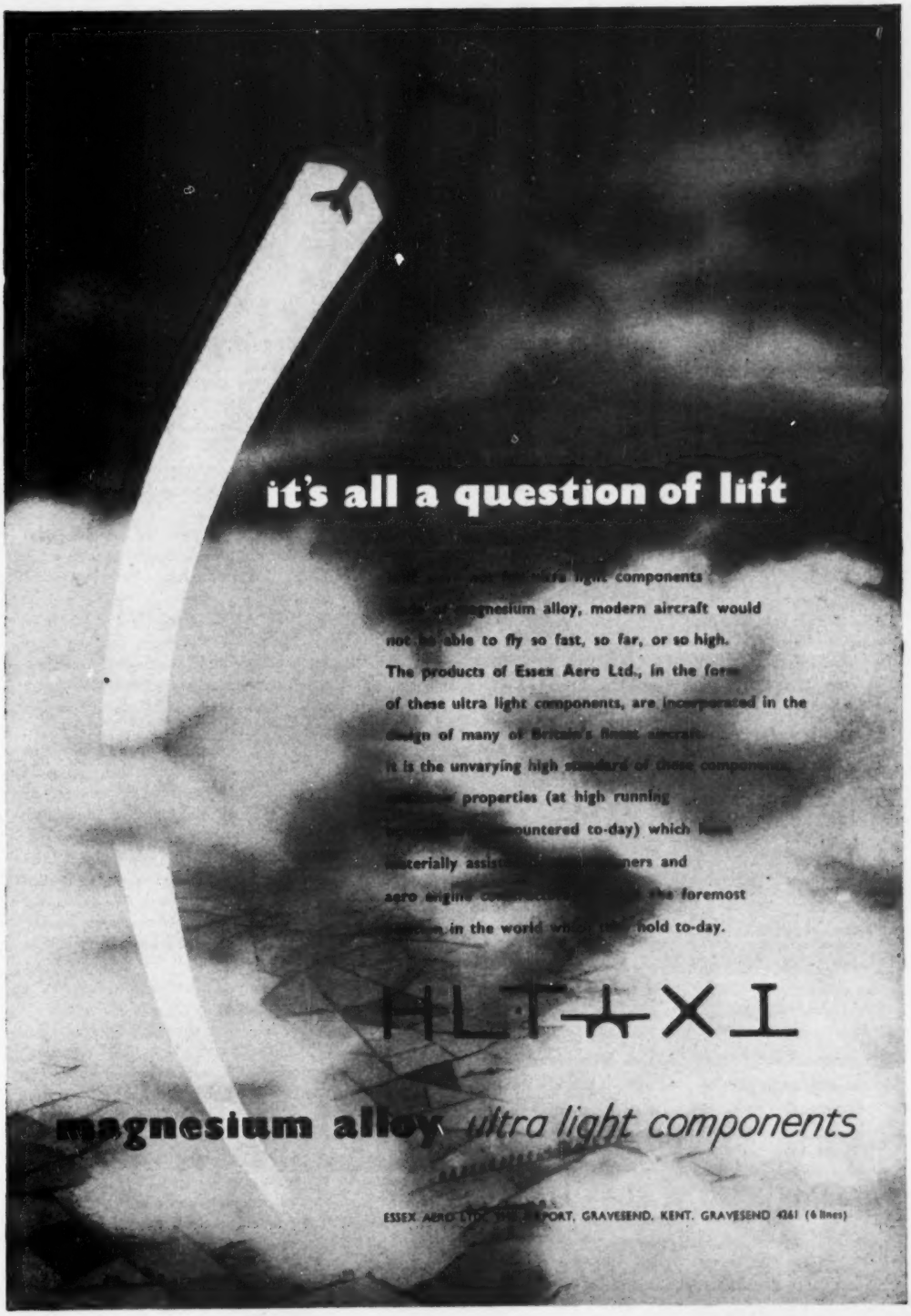
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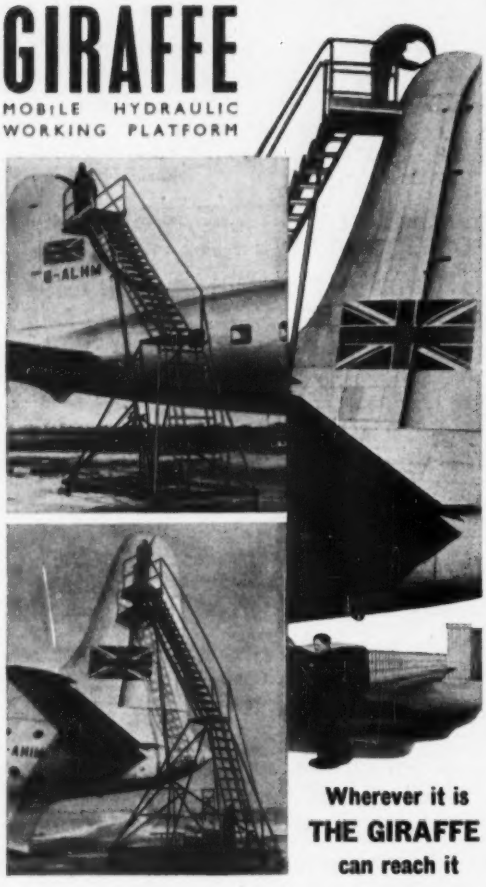

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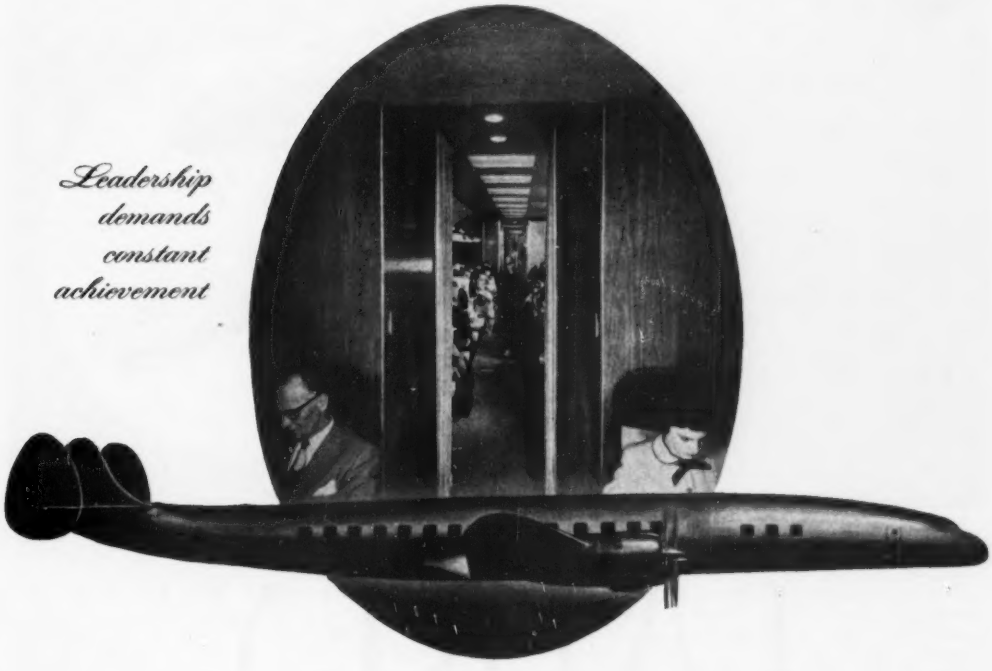

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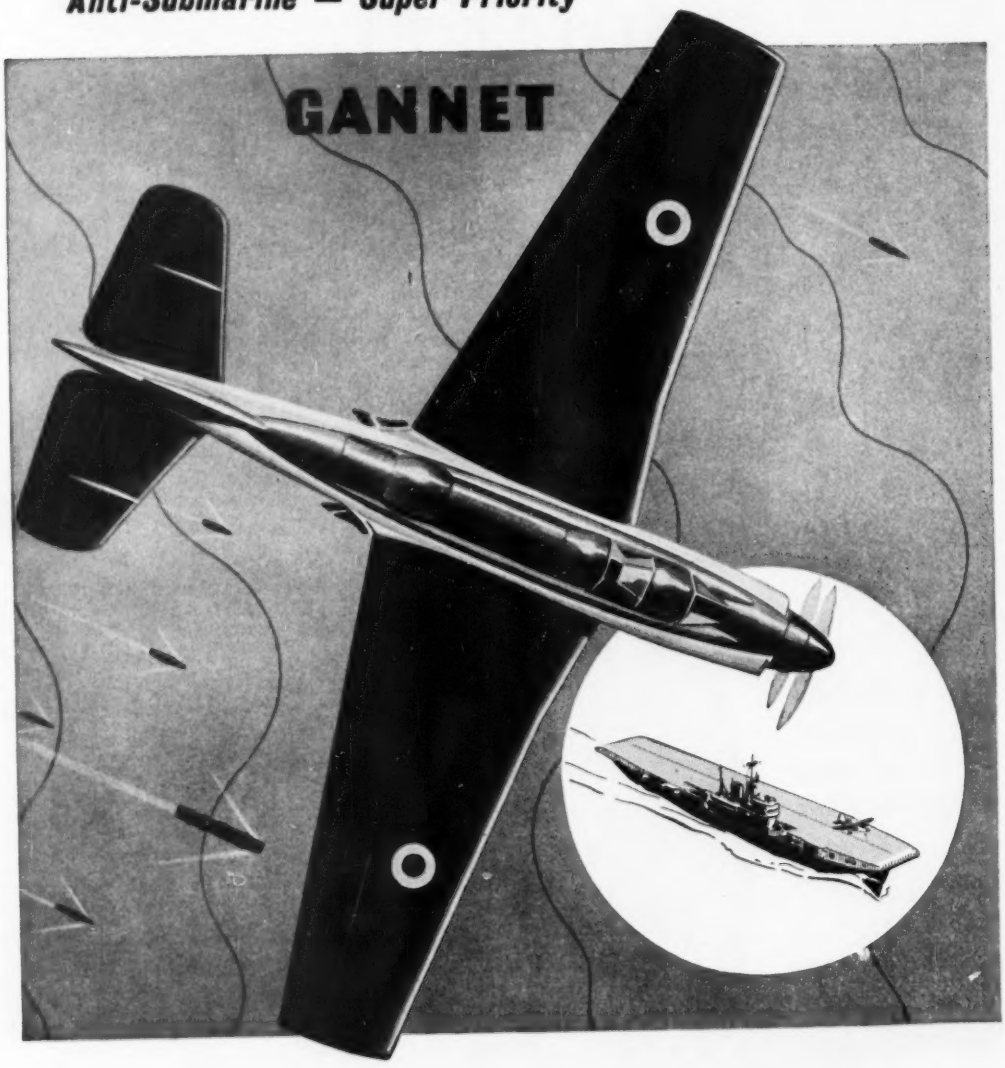

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First Aeronautical Weekly in the World

Founded 1909

No. 2289 Vol. LXII. FRIDAY, 5 DECEMBER 1952

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Encouragement to Fly

LAST week brought a welcome announcement regarding aid for private pilots. It was made by the new Parliamentary Under-Secretary to the Ministry of Civil Aviation speaking at the A.B.A.C. dinner on behalf of his Minister (see page 713). Taking the form of a monetary grant per hour, the new scheme is, in effect, to be an extension of that now operating so successfully for A.T.C. flying scholarships. For the qualified and suitably experienced private pilot, flying in light aircraft need now cost only about 15s per hour if he carries a selected A.T.C. cadet as passenger.

It is not, of course, the intention to give flying instruction to these cadets at this stage, but rather to give them a stimulating introduction to the air, to demonstrate the effect and use of aircraft controls, and to explain the rudiments of navigation and map reading. This can all be done in an interesting and personal manner in a club light aircraft, and will undoubtedly be more valuable to a cadet than a ride in the back of an Anson for "air experience."

This most welcome gesture on the part of the Government should help not only the pilots who take part but the clubs as a whole. It is to be hoped, also, that by sharing of costs and reduction of rates it will assist the young club members who have so far been unable to afford flying instruction. We must confess to being even more concerned about the opportunities—or lack of them—for these latter than about the pilots who already have sufficient experience to profit directly from the £2 5s per hour grant. Unless a young man manages to learn to fly with one of the Regular or Reserve Services the only way open to him is still the hard-cash way of 30 to 40 hours on club machines at not less than £3 per hour on the average.

We look forward to a resumption one day of the pre-war R.A.F.V.R. practice of accepting suitably qualified young men for pilot training without previous experience. The important reclassification of present V.R. pilots, to which we referred last week, may possibly be a prelude.

We are hopeful that the many voices which are now so frequently raised on the subject of airmindedness, and of opportunities for the youth of the country to play an active part in the new Elizabethan air age, will result in action to make this aim practicable.

Weighty Considerations

WEIGHT saving has remained a standard topic for aeronautical shop-talk since the Wrights were boys; and yet, as a result of its familiarity, perhaps, the continued significance of lightness is not always fully appreciated. There is not an aircraft flying which could not be a little lighter without impairing a single safety-standard.

The addition of weight to an airframe—in these days it usually takes the form of desirable, if not essential, extra equipment—has a snowball effect, first on structure weight, then on power requirements, fuel, cost and, finally, performance. How many clean and exciting prototypes have been slowly weighted down until eventually the only recognition of their potential merit and early promise has been provided by their decorations, of Christmas-tree splendour.

These simple thoughts, together with some striking figures for pounds avoirdupois expressed in terms of pounds sterling, have set us wondering whether the non-technical qualifications for selection of Comet aircrews, for example, might not with advantage include that of a sylph-like form. The assistant chief designer of the Comet, Mr. C. T. Wilkins, has stated that one pound of payload on a loaded B.O.A.C. Comet represents £55 per annum per aircraft in terms of passenger weight, or £38 as freight. Moreover, each pound of payload carried requires half-a-pound of extra fuel. The normal aircrew comprises five men including the steward and one stewardess, and their combined weight is on average, 870 lb. In terms of load carried they therefore represent just over £33,000 per annum at the lower rate. There should be little difficulty in finding crews—excluding the captain, perhaps—which allowed a 10 per cent saving in this average of weights. With a fleet of a dozen aircraft this could represent a welcome positive figure on an (out of) balance sheet. For a start, stewards might be recruited in the Newmarket and Epsom areas.

HYDRO-SKIS

The Background of Development in America: Britain in the Running

ONE of the most engaging topics touched upon by Mr. Henry Knowler in his Louis Blériot lecture (*The Future of the Flying-boat*) early this year was the hydro-ski. This he described as being somewhat allied to the hydrofoil. He explained that it obtained its lift from the water pressure on its lower surface in a similar manner to the planing lift of a boat's planing-bottom; but it allowed a considerably higher loading to be used and, in consequence, a more acute attitude of the planing surfaces was necessary. Compared with that of a normal boat-form the efficiency was poor; but the system had the advantage that complete retraction into a streamline body was relatively simple.

Many readers will recall the Hook Hydrofin and the jet-propelled boats of the late John Cobb and of Mr. and Mrs. Hanning-Lee. While the Hydrofin and the Hanning-Lee craft were designed to ride on hydrofoil surfaces, the Cobb boat was equipped with outrigger floats. On none of these craft was the true hydro-ski principle, as described by Mr. Knowler, embodied. It is also appropriate to mention here the Bristol-built Burney Hydroped of nearly forty years ago and early Italian experiments with hydrofoils.

Though a comparatively recent development, hydro-skis have been the subject of considerable research both in England and America, and their application to specific high-speed aircraft has been investigated. Mr. Knowler revealed that the possibility had been shown of having a highly stable hydro-ski system capable of lifting an aircraft body off the water at relatively low speed. He added that, despite the low hydrodynamic efficiency of the ski, the system was very suitable for water-based fighters, due to the possibility of total retraction.

It is now known that this suitability will be exploited in the Convair XF2Y flying-boat fighter being developed for the U.S. Navy. Announcing this recently, Mr. John F. Floberg, Assistant Air Secretary of the Navy, justly claimed that the application of the hydro-ski to the new machine would be the first of its kind on a military aircraft.

It must, however, go on record that Saunders-Roe have themselves designed a high-speed water-based fighter using the hydro-ski principle. Though capable of taking off from water, this machine is not a flying-boat in form, and—again we quote Mr. Knowler—"when in flight would be on equal terms with the equivalent land-based aircraft." In this design the turbojet intake is above the fuselage and is in the form of a pitot entry, developed in a wind tunnel to give high overall efficiency.

To synchronize with Mr. Floberg's announcement, the U.S. Navy have released some highly interesting details of hydro-ski development under their sponsorship. They visualize water-based ski-planes of the future, extending their hydro-skis, touching down on the water and taxying on the skis to a ramp at the water's edge. Then, rolling on small beaching wheels set in the skis, the aircraft would ascend the ramp without ground assistance and taxi to their parking space.

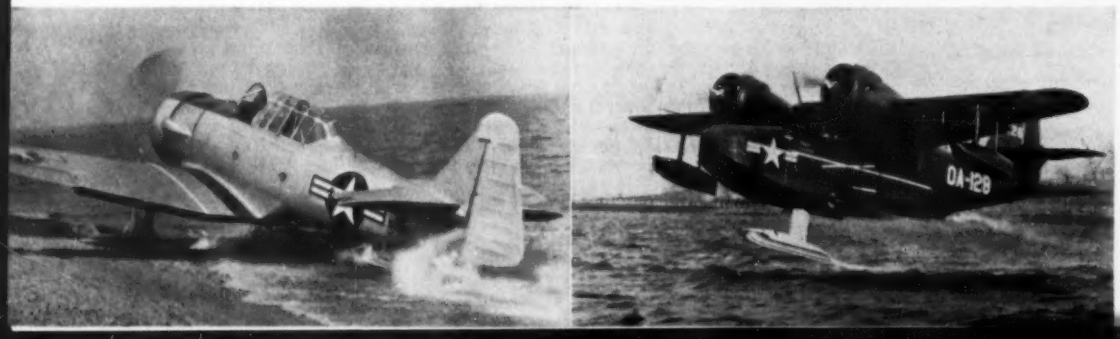
Although Canadian bush-pilots have occasionally operated snow-ski aircraft from water as a matter of necessity (they found that they could slide off frozen ice or mud on to open water and quickly accelerate to take-off speed), it is claimed that it was the National Advisory Committee for Aeronautics that initiated investigations into the use of hydro-skis on current high-speed seaplane designs. Early N.A.C.A. investigations consisted of dynamic-model tests centring around the application of hydro-skis to a modified version of the Douglas Skyrocket research aircraft. The idea was not to develop a hydro-ski gear for the Skyrocket, but rather to test the feasibility of the scheme for application to a typical high-speed aircraft.

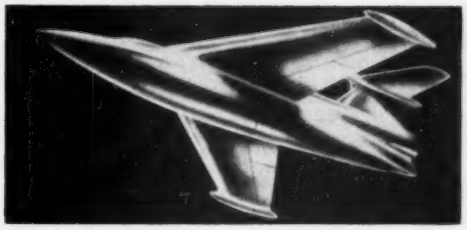
The dynamic-model experiments allowed an evaluation of the new configuration and tests of the modified D-558 gave "surprising and encouraging" results. Thus, it was found that landings in rough water at high speeds were relatively smooth and unusually stable. The model could be landed over a wide range of attitudes—nose high, nose low, yawed and rolled—without upsetting. From resistance tests it was estimated that the full-scale aircraft would have sufficient thrust available for take-off. Finally, it was decided that the hydro-ski gear could be used for practical high-speed marine aircraft.

Credit for the first trial application of the hydro-ski to a full-scale aircraft goes to the Edo Corporation, which installed a single main hydro-ski on a fixed strut under a Grumman JRF-5 amphibian flying-boat. This pioneering effort was the outcome of a U.S.A.F. project and was intended primarily "to furnish a test article for multi-base operations." It was demonstrated by Edo that the gear allowed operation from ice, snow and water, and sufficient hydrodynamic tests were made to show that water operation was a practical matter. Extensive snow and ice tests, however, left the machine in too poor a mechanical condition to obtain additional hydrodynamic data. Accordingly, a second JRF was modified to incorporate a similar, but improved, hydro-ski gear, this time under the sponsorship of the U.S Navy's Bureau of Aeronautics.

This flying test-bed is now undergoing extensive hydrodynamic trials at the Naval Air Test Centre. At rest in the water it looks like a standard JRF-5; once under way, however, the machine rises bodily, and at about 20 kt the attitude increases sharply and the nose of the hydro-ski breaks through the water surface with a short burst of fine spray. Thereafter the machine rides on the ski and rapidly accelerates to take-off. During landing, of course, the ski touches the water first and in rough water presents only a small area for impact against oncoming waves. As the aircraft decelerates the ski assumes more and more load, until finally, when the load becomes great enough, it submerges, allowing the

Left, U.S. Navy SNJ (Harvard) fitted by All American Airways with a hydro-ski installation designed to test the feasibility of the scheme as applied to conventional landplanes. Wheels are an integral part of this installation, allowing the machine to roll up on a batch or ramp and to permit it to operate from a grass strip. On the right is the Grumman JRF-5 test-bed fitted with a hydro-ski by the Edo Corporation. This is a fixed, non-retractable installation, used to obtain data for more advanced designs.





Proposal for a fighter ski-plane by Mr. Henry Knowler.

Tank test of a hydro-ski-equipped model of the Douglas Skyrocket.

aircraft to float in the water. The settling is described as a "gentle and not unpleasant manœuvre."

Subsequent to the tests described All American Airways initiated flight tests of hydro-ski-equipped aircraft under BuAer contract, taking a somewhat different line. Installing planing surfaces on the normal undercarriage of a Piper Cub they found that alightings could readily be made on the water and that water-taxying could be accomplished at relatively low speed, provided, of course, that the speed was not reduced below the water-stalling speed of the planing surfaces. Wheels were then introduced which projected slightly below the planing surface, and it was shown that unassisted operations could be made from grass runways, that the aircraft could be landed in the water, and that, maintaining water-planing speed, it could be taxied on to a sandy beach. Moreover, it could be taxied back into the water for take-off provided that a certain minimum speed was reached before entering the water.

Various arrangements of this planing-surface gear with wheels have been tested, including installations on an SNJ (Harvard) of the U.S. Navy. With only minor preparations, it is claimed, unassisted operations from a beach or ramp is a practical matter for the aircraft so far tested. Alighting and taking off becomes a fast and simple manœuvre, eliminating the need for beaching gear, beaching cradles, mooring buoys and associated equipment. This type of operation, it is said, eliminates the low speed and hydro-ski surfacing problems inherent in the designs first tested, but it introduces the additional risk of "dunking" the aircraft in the event of engine failure or inadvertent water-stalling. This danger of the inadvertent water-stall has been greatly reduced by practising deliberate stalls in shallow water, so that pilots now recognize an approaching stall and can take the necessary action.

Seaplane-tank investigation of a model incorporating a twin hydro-ski gear, for comparison with the single ski previously mentioned, is reported to have given considerably different hydro-dynamic stability characteristics than the single-ski configuration. In the meantime, it was sought to apply available information to more advanced designs. A study was made of a hydro-ski installation on the Convair Skate high-speed seaplane design, originally developed for use without skis. An optimum ski-plane design obviously could not result from this adaptation, but, nevertheless, the study permitted evaluation of the effects of installing hydro-skis on a current high-speed marine aircraft design. The results showed, in part, marked improvement in rough-water take-off and landing characteristics, and it was considered that a practical installation could be made.

Encouraged by the results obtained thus far, BuAer have undertaken the development of a high-speed aircraft—doubtless the new Convair fighter referred to by Mr. Floberg—embodying many of the most favourable features of the experimental installation, and the U.S. Navy now considers it safe to look to the future for water-based aircraft with excellent aerodynamic performance, improved water take-off and landing characteristics, and simplified methods of beaching and ground handling.

FIRST AVRO-BUILT CANBERRA

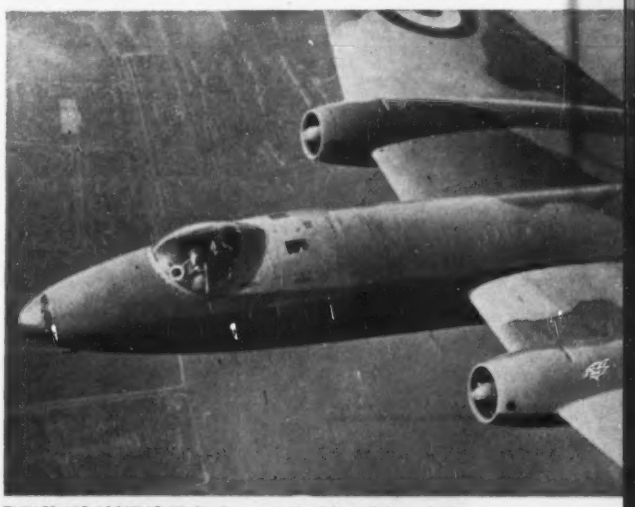
AVRO test pilot J. D. (Johnny) Baker, whose distinctive performances on the Shackleton have been much appreciated by Farnborough-goers for some years past, was at the controls of the first Avro-built Canberra for its maiden flight on November 25th. He took off from Woodford at 12.22 p.m. and landed back after 45 minutes.

Previously restricted to 42,000ft—the absolute ceiling of the Ashton, achieved only after building up speed on the level—the Avro pilots will now be required to fly far above that height while testing production Canberras.

It is the belief of Sir Roy Dobson, Avro managing director, that delivery of this first Canberra only two years, fourteen days from the word "go" constitutes a production record. With one "small exception" Avros built all the major components themselves. The machine heads a full production-line.

The following telegram has been sent to Sir Roy by the Minister of Supply: "I am very glad indeed to hear that you have produced your first Canberra aircraft exactly on time. Warmest congratulations to all who have played a part in this effort. Best wishes. Duncan Sandys."

The Avro-built Canberras, like those being constructed by Short Bros. and Harland, Ltd., and Handley Page, Ltd., are of the standard B.2 (tactical bomber) model, powered by two Rolls-Royce Avons of unspecified mark. It will be recalled that the first Short-built Canberra made its first flight at Belfast on October 30th. Under the designation B-57A a night-intruder version of the type is in production at the Glenn Martin factory.



THINGS ARE LOOKING UP for Avro test-pilot Johnny Baker, who has spent most of his flying time in recent years in heavy, piston-engined Shackletons, but who, as seen (and reported) here, air-tested the first Avro-built Canberra on November 25th. Note for collectors: the serial number is WJ971.

FROM ALL QUARTERS

A. W. Meteor N.F. 11s for Denmark

LAST Friday, November 28th, four Armstrong Whitworth Meteor N.F. 11s were delivered to Denmark—the first of "a substantial order" placed by the Danish Government, as foreshadowed in *Flight* some months ago. In the words of Mr. H. M. Woodhams, C.B.E., F.R.Ae.S., Armstrong Whitworth managing director, "since these aircraft form the backbone of Western Europe's night air defence, the total number to be delivered to Denmark cannot be revealed."

He went on to say: "When accepting this big new export order we made plans to ensure the uninterrupted flow of N.F. 11s to the R.A.F. Ready co-operation between management and employees in these plans guarantees fulfilment of the dual commitment."

Deliveries, it is stated, will be made in a steady stream over a fairly long period. The initial four aircraft, fully equipped and wearing Danish Air Force insignia, were collected by Danish pilots who flew them off immediately, reaching their home base about an hour later.

Developed by Armstrong Whitworth from the basic Gloster design, the N.F. 11 (two Rolls-Royce Derwents) shares certain characteristics of the Meteor Mks 7, 8 and 10, but its most noticeable feature is the long radar nose. Four 20 mm guns are mounted in the wings, outboard of the engine nacelles.

West Indian Viscounts

THE "undisclosed operator" mentioned in last week's *Flight* as having ordered three Vickers-Armstrongs' Viscounts is now known to be British West Indian Airways, a subsidiary of B.O.A.C. A joint announcement published on Tuesday by Sir Miles Thomas, as president of B.W.I.A., and Sir Errol L. dos Santos, chairman, stated that the aircraft would be used in operation in the Caribbean and West Indies; delivery was expected in the early part of 1955.

The T.C.A. order for 15 Viscounts announced recently is likely to result in the first "penetration" of the United States by a British turbine-powered aircraft—late in 1954, when the Viscounts are expected to enter service on the Toronto-New York-Montreal triangle. Not long afterwards Viscounts may well make a second appearance, farther south, since B.W.I.A. hold a C.A.B. permit to operate between Miami and Trinidad *via* Jamaica.

Pathfinder Ball

ONCE again the Pathfinder Club's ball—held at the Dorchester Hotel, London, last Saturday—was a great success. The organization was in the hands of Secretary Alex Thorne assisted by Messrs. L. G. ("Johnny") Johnson and Peter Swan. Nearly 600 attended, and among the guests were Sir Thomas White, the Australian High Commissioner, and Sir James Barnes, Permanent Under-Secretary of State, Air Ministry, and Lady Barnes.

Special reference was made during the evening to the film *An Appointment in London*, which is to be released early in the New Year. The Pathfinder Association is co-operating with the R.A.F. Association in presenting the world première. A reference has already been made in our pages to the film, the story of which is based on a squadron in Bomber Command. Mr. John Wooldridge, who wrote the script, was present with his wife Margaretta Scott, who gave away the prizes. Mr. Wooldridge was a 5 Group Pathfinder.

Trooping Costs

A RECENT statement by the Secretary of State for Air that it is cheaper by some £4 to fly a serviceman to the Middle East than to take him by boat adds interest to some recent estimates of the cost of trooping in new or projected aircraft.

According to the Chief of Air Staff (as reported in our pages a fortnight ago), two long-range, four-engined jet transports, with two in reserve, could lift in a year, between the United Kingdom, the Middle East and the Far East, more troops more cheaply than two of the latest troopships. The capital cost of the aircraft might be £1m. and the cost of the troopships perhaps £9m.

An assessment made for a fleet of Bristol Britannias fitted out as troop-carriers shows that on a non-stop service between Great Britain and the Middle East each aircraft could carry 130-140 fully-equipped troops at a cost of £15 per man per journey. Flight time would be six to seven hours. A similar assessment of the London-Far East route envisages a 27-hour journey with three stops. Each Britannia would carry 120 troops and the cost would be £55 per man.

Projected pure-jet troop transports include a version of the Vickers Valiant and a Handley Page. According to a recent statement by the Secretary of State for Air, a Valiant transport might be capable of carrying 150 passengers at 45-50,000ft for 2,000 miles (England-Egypt) in four hours. Estimates show that the Handley Page could carry 148 fully-equipped troops on a 2,000-miles non-stop flight in 4½ hours at a cost of under £7 per man. A 4,000-mile flight, taking 8 hours, would work out at £30 each for a load of 94 men.

O.U.A.S. Entertains

LAST Friday the Oxford University Air Squadron held their annual dinner in their town headquarters. The distinguished assembly present on such occasions seldom fails to show how happily Air Force experience blends with academic distinction—one serves as a foil to the other, so making the gathering singularly pleasant.

Among those present—in addition to those mentioned below—were Air Marshal Sir Basil Embry, A.O.C.-in-C. Fighter Command, Air Marshal H. T. Lydford, A.O.C.-in-C. Home Command, and two commanding officers of nearby U.S.A.F. bomber stations, Col. Thomas G. Corbin (Brize Norton) and Col. Alvan C. Gillem (Upper Heyford).

The O.U.A.S. commanding officer, W/C. F. A. Willan, welcomed his visitors with a concise and modest speech refreshingly free from statistics. He did, however, refer to the squadron's activities during 1952 and he expressed great satisfaction with the work of the newly-received Harvards, with which they had put in "bags of hours." Also welcome was the increased establishment of instructors, and W/C. Willan praised the ground crews for their hard work. But in spite of the latter fact, O.U.A.S. counted itself unique in that its bowser had been serviced by an air commodore.

Replying, Air Marshal Sir Ronald Ivelaw-Chapman, Deputy Chief of the Air Staff, said he was going straight to the point—that the O.A.U.S. consisted of sensible chaps, who realized that they lived in an "air age." The Air Squadron was not to be regarded as a mere source of recruits, but rather as a means of increasing aeronautical interest in the widest sense.

Proposing the toast of "The Squadron," the Vice-Chancellor of the University, Sir Maurice Bowra, Warden of Wadham, began his lively discourse by remarking that he had in front of him "a better-looking lot than I get on an ordinary degree day," and concluded that, at any rate, young men capable of driving cars to the danger of the public could certainly fly aeroplanes to the danger of the enemy.

Fulfilling in bright and uninhibited style the somewhat onerous task of replying, Mr. Alan Stewart of Brasenose regretted the presence of so many "Yanks at Oxford" who flew far more intrepid aircraft than did the squadron. But they (O.U.A.S.) still had their Harvards, and Mr. Stewart went on to describe this familiar trainer in altogether unique terms.

THE DUKE OF EDINBURGH shakes hands with the chairman of B.E.A., Lord Douglas of Kirtleside, before boarding R.M.A. "Sir Francis Bacon" for Malta. Also present are Mr. Peter Masefield, B.E.A. chief executive (on left); Capt. W. Baillie, chief flight captain, B.E.A.; and Sir John D'Albiac, London Airport commandant. A picture of the aircrew is on page 711. While the Duke was in Malta he boarded H.M.S. "Theseus" to watch a display by the carrier's aircraft. Five squadrons—two more than usually carried—were catapulted off; many of the pilots who took part are shortly to go to Korea, where "Theseus" served in 1950.

Schneider Trophy Pioneer Dies

FRENCH aviation circles are mourning the passing of one of their great pioneer pilots, Maurice Prévost, who died at Neuilly on Thursday of last week after heart failure. He was the winner of the first Schneider Trophy Contest.

He learned to fly at the Deperdussin school at Bétheny, near Rheims, in 1910—by the method, unorthodox even in those days, of taxying one of the school's "penguins" to a deserted corner of the field, undoing its control-limiting devices, and taking off to make a perfect circuit.

Within the next two years, flying "Deps," he came right into the front rank of pilots, securing a number of height and distance records, finishing as runner-up to Jules Vedrines in the 1912 Gordon Bennett Race in America, and being placed second (and first Frenchman) in the British Military Trials in the same year.

He gained his Schneider Trophy victory at Monaco in 1913. The new Deperdussin single-seat seaplane which he was to have flown would not unstick from the smooth water during the eliminating trials, and he had to use, instead, an old three-seater which, with a top speed of under 75 m.p.h., was slower than most of his rivals. But his aircraft was reliable, whereas its competitors were either unreliable or met rough water and bad luck: Prévost was the sole finisher.

In the Gordon Bennett Race of the same year, which he won, he beat his own world speed record of 112.4 m.p.h.

During the 1914-18 war Prévost tested hundreds of aircraft for the French and Allied Governments. He continued flying until

Maurice Prévost "at the wheel" of a Deperdussin.

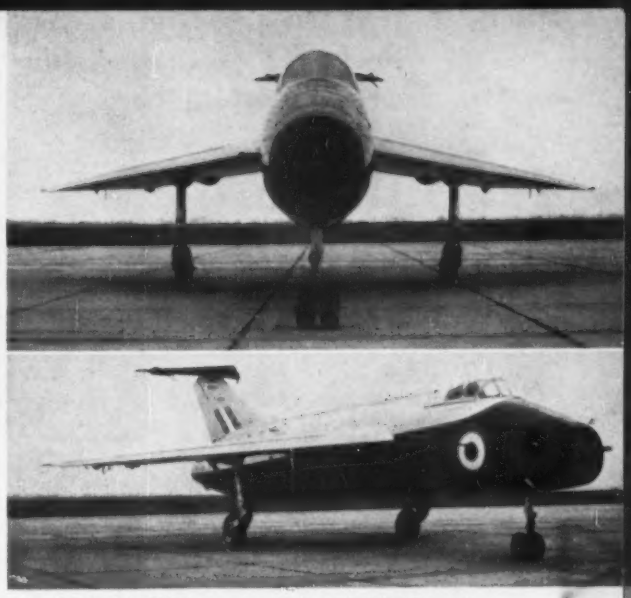
1924, when he joined Standard Française des Petroles, the Esso marketing agents in France; five years later he was appointed manager of their aviation department. He retired from the firm three months ago.

Hawker Occasion

CURTAIN-RAISER at the apprentices' prizegiving of Hawker Aircraft, Ltd., at Kingston-on-Thames last Friday, was the Shell film *Highlights of Farnborough, 1952*, in which, appropriately, the first aircraft shown was the Hunter. After the film, Mr. A. N. Spriggs (general manager) described the occasion as the most important night of Hawkers' year: in addition to the award of prizes to the apprentices, who were just beginning their service with the company, employees who had been with the firm for 25 years were to be presented with clocks.

These were first handed to the 23 long-service employees by Mr. Spriggs, Mr. Sydney Camm, C.B.E., F.R.Ae.S. (chief designer), and Mr. J. T. Lidbury (secretary). Mr. Camm, addressing the apprentices, spoke of the tremendous scope which existed for keen, creative brains: the lines along which future developments would proceed were by no means defined. He wished the apprentices the best of luck—but did not want to see them all in the drawing office, for there was much scope in the works also.

As the best apprentice of the year, A. E. Sheridan, was away on R.A.F. service, the Apprentices' Trophy was received by his father. A replica was presented to John Goddard, last year's winner, who is at present engaged on research at the College of Aeronautics. After Mr. Lidbury had outlined the history of the apprentice scheme, and affirmed the directors' interest in it, prizes of books and instruments were presented to eight other apprentices.



ADJUSTABLE SWEEPBACK characterizes this Short S.B.5 (R-R. Derwent) first flown at Boscombe Down last Tuesday by Tom Brooke-Smith. Designed by Mr. D. Keith-Lucas, it is intended for low-speed experiments with swept wings. "Droop-snoot" flaps, are, apparently, fitted. These are the first pictures released.

In conclusion, Mr. R. W. Sutton spoke on behalf of the group of original Sopwith apprentices who had donated the Hawker Apprentices' Trophy. The Trophy was intended to express their satisfaction in having received their early training with the firm, whose rapid progress during the past 40 years gave the present-day apprentices cause for much pride.

R.Ae.S. at Henlow

AS recently reported in these columns, Henlow (Beds.) is among the centres of aeronautical activity at which new branches of the Royal Aeronautical Society—bringing the U.K. total to 23—have been formed.

The inaugural meeting of the Henlow Branch took place recently at the Royal Air Force Technical College, distinguished guests including a number of senior officers from the technical branches of the Air Ministry and from Technical Training Command H.Q., together with Maj. G. P. Bulman (R.Ae.S. past president) and Dr. A. M. Ballantyne (secretary).

At the election of officers for the branch, S/L. D. Mc. L. Ferrier was nominated president and F/L. D. J. Cockrell hon. secretary; both are stationed at the R.A.F. Technical College.

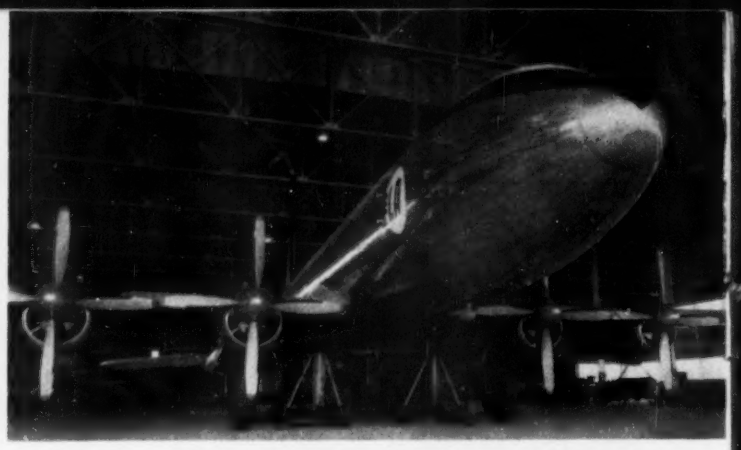
As well as serving the interests of the large numbers of technically minded R.A.F. personnel at Henlow, the new branch is within comparatively easy reach of the National Aeronautical Establishment, Bedford, and the College of Aeronautics, Cranfield. There are also a number of firms partly or wholly engaged on aircraft work in the area.

Austers in Japan

IN keeping with the enterprising sales policy which has shown such excellent results in the post-war years, the chief test pilot of Auster Aircraft Ltd., Ranald Porteous, has been giving a series of highly successful demonstrations to potential buyers in Japan. One of his displays—at Tamagawa, on the outskirts of Tokyo—was given in honour of the Crown Prince of Japan, whose proclamation as heir-apparent was made on the same day. Included in the repertoire of aerobatics was the so-called "avalanche"—a flick roll at the summit of a loop—which Porteous first performed in public at Farnborough last September. This breath-taking manoeuvre had the desired effect on the display-starved Japanese audience of 20,000. Similar displays were given at Osaka and at Hamanatsu, which, as the headquarters of Japan's National Police Reserve, is likely to be the centre of that country's air force if and when rearmament is permitted.

Despite the possibility of American aid in the form of training aircraft, there may well be a demand for the Aiglet Trainer in view of its economy coupled with excellent aerobatic characteristics. Already, it is believed, private operators have placed several orders for Aiglet Trainers and Autocars as a direct result of the sales-cum-demonstration tour by Porteus. His performances, incidentally, were not given in a special demonstration aircraft as is normally the custom, but in standard production machines already in service and temporarily borrowed for the purpose.

HERE AND THERE



AN AVRO TUDOR, once employed on the Berlin Airlift, is being modified at the A. V. Roe Canada factory at Malton for use as a freighter in the Canadian Northland. It is seen jacked-up for weighing by electronic recorders; 47,500 lb was the figure given. Just visible in the background is the Avro Canada Jetliner.

National Air Races: Southend

THE Royal Aero Club announces that next year's National Air Races will be flown at Southend-on-Sea Airport, on Saturday, June 20th. The meeting, organized in conjunction with the Southend Corporation, and with the support of the Kemsley Flying Trust, will include the King's Cup Air Race.

M.C.A. Appointment

THE Minister of Transport and Civil Aviation, Mr. Lennox-Boyd, has appointed Col. Cyril Banks as Joint Parliamentary Private Secretary.

Minus 500 Migs

THE shooting down of five Mig aircraft over North Korea by American Sabres on November 20th brought the total number of such aircraft destroyed by Sabres to 502.

Gliding Championships

NEXT year's National Gliding Championships will be held at Great Hucklow, Derbyshire, from July 25th to August 3rd. It is hoped that they will form a useful rehearsal for the International Championships, to be held at the same site in 1954.

Pembrokes for Belgium

A SUBSTANTIAL quantity of Percival Pembroke general purpose aircraft is the subject of a contract recently placed by the Belgian Air Force. A development of the civil Prince and of the Royal Navy's Sea Prince, the Pembroke will carry eight passengers in rearward-facing seats; other typical loads are six stretcher patients or a useful quantity of freight. Special modifications on the Belgian machines will include a transparent nose section of the navigator/bomb-aimer type and camera hatches for survey and general photography.

MANHOLE-COVER: To ensure safety for personnel during ground-running, Saab have designed this sturdy tubular-steel guard for the intake of the J-29's Ghost.

Air Espionage Accusation

A U.S.A.F. sergeant, Guiseppe Cascio, has been accused of selling to the North Korean Communists secret information concerning the Sabre. Military police said that "incriminating documents," including photographs, were found in Cascio's possession.

Taking It

THE efficacy of rearward-facing seats received fresh proof last week when an R.A.F. Valetta crashed near Boscombe Down after a collision with a Venom on the approach. Although the transport was completely wrecked, there were only four cases of injury among the 12 occupants (R.A.F. crew of four, and eight soldiers). The Venom pilot lost his life.

New Sapphire

EXISTENCE of a new version of the Armstrong Siddeley Sapphire turbojet, the ASSa 7, has been disclosed. No performance figures are released, but it will be recalled that the Sapphire ASSa 6 was stated to have a static thrust of 8,300 lb. Like the Double Mamba turboprop produced by the same firm, the new Sapphire can function efficiently on kerosine, diesel oil or "wide-cut" turbine fuel. The ability to use ship's diesel oil is of obvious advantage for carrier operation of the Fairey Gannet, which is powered by the Double Mamba; the Sapphire is not yet installed in any carrier-borne aircraft.

Transport by Air for U.S. Army

CONSISTING of some 2,200 helicopters and light aircraft, a "specialized aviation unit" is to be built up by the United States Army. General J. Lawton Collins, U.S. Army Chief of Staff, stated that the Army does not intend to usurp any functions of the Air Force; these aircraft would be an integral part of the infantry equipment and would provide transport for soldiers and weapons only within combat zones, supplementing conventional ground transport. General Collins spoke of the value of the helicopter, particularly for taking guns and men across rivers where bridges had been destroyed. "We are willing to sacrifice range and speed in order to get greater lifting capacity for short distances," he stated, "and I visualize the lifting of weapons as big as 155 mm (6in) howitzers across rivers." The Army would have a unit of large cargo-helicopters in Korea in the near future, and this type would constitute about 1,100 of the total number of 2,200 aircraft. Of the remainder, approximately 1,000 would be light fixed-wing aircraft.

Obstructionist

AN airport employee who cycled across a runway at Northolt in the path of a landing aircraft was fined £5 at Uxbridge last week. The pilot had to lift the aircraft in order to avoid him.

Old Boys' New Name

THE name of the association of past students of the College of Aeronautics has been changed from the Cranfield Aeronautical Society to "The Cranfield Society." The Society's annual general meeting and dinner will be held at the College on March 14th.

Atlantic Flight Memorial

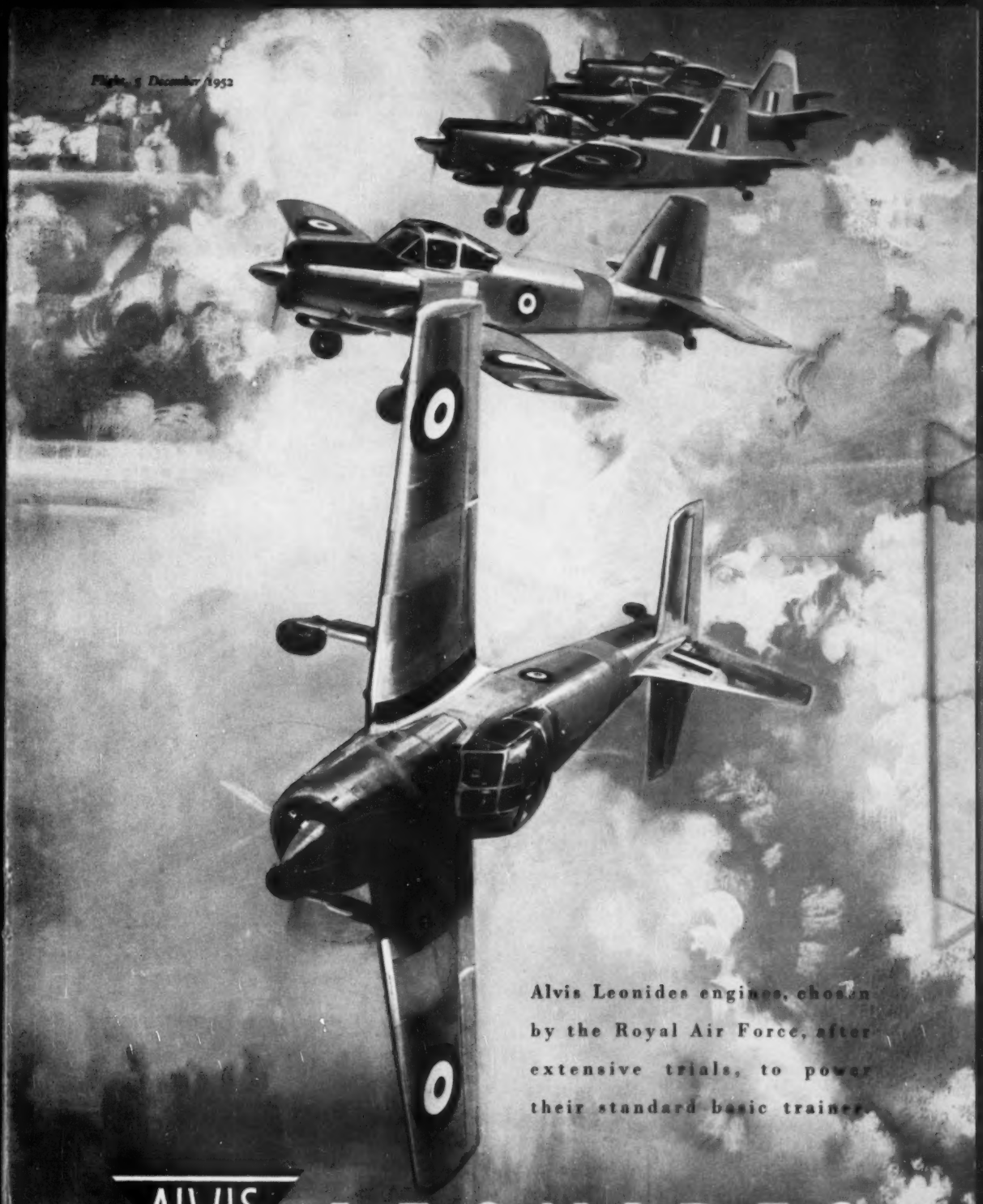
A MONUMENT to Sir John Alcock and Sir Arthur Whitten Brown, the Atlantic-flight pioneers, was unveiled on November 26th at St. Johns, Newfoundland, near the field from which their Vickers Vimy took off on June 14th, 1919. Capt Douglas Fraser, a pioneer Newfoundland pilot, performed the ceremony.

Indian Vampires

INDIA is shortly to begin manufacture of Vampires under licence from de Havillands. The Hindustan aircraft factory in Bangalore, which is already assembling British-made Vampire components, will change over to manufacture next year. At first, only the airframes will be built there, and engines will continue to be imported from England, but the eventual manufacture of the complete aircraft is intended.

Mustangs for South Koreans

THE Australian Government is to give 51 Mustangs to the rapidly growing South Korean Air Force, the first such gift by a United Nations country other than America. Mr. William McMahon, Australian Minister for Navy and Air, was due to present the first two to Maj.-Gen. Chai Yung Duk, Deputy Chief of Staff of the South Korean Air Force, at a ceremony last week at an airfield in Southern Japan.



Alvis Leonides engines, chosen by the Royal Air Force, after extensive trials, to power their standard basic trainer.

ALVIS

LEONIDES

ALVIS [illegible] COVENTRY [illegible] ENGLAND

NEW COMMERCIAL

Up-country medical services

Postal services

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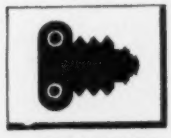
POWER LINES

FORESTRY CONTROL



PHOTOGRAPHIC

WESTLAND

VEHICLES OF UNLIMITED SCOPE

Westland Helicopters have now proved themselves in many service and commercial roles in all parts of the world. They are the only Helicopters of proved efficiency immediately available from a current production line. Both S.51 (3 passengers and 1 pilot) and the S.55 (10 passengers and 2 pilots) are unique in having all-metal rotor blades as well as servo-controls for non-fatigue flying. Commercial operators appreciate their ease and cheapness of maintenance under world-wide conditions. Westland's private enterprise offers unrivalled delivery dates for both S.51 and S.55 Helicopters, also world-wide service and helicopter pilot training.

Up-country supply lines

S.55 HELICOPTERS

- **ALL-METAL BLADES**
- **HYDRAULIC SERVO-CONTROLS**
- **400 MILES RANGE**
- **1 TON FREIGHT OR 10 PASSENGERS AND 2 PILOTS**

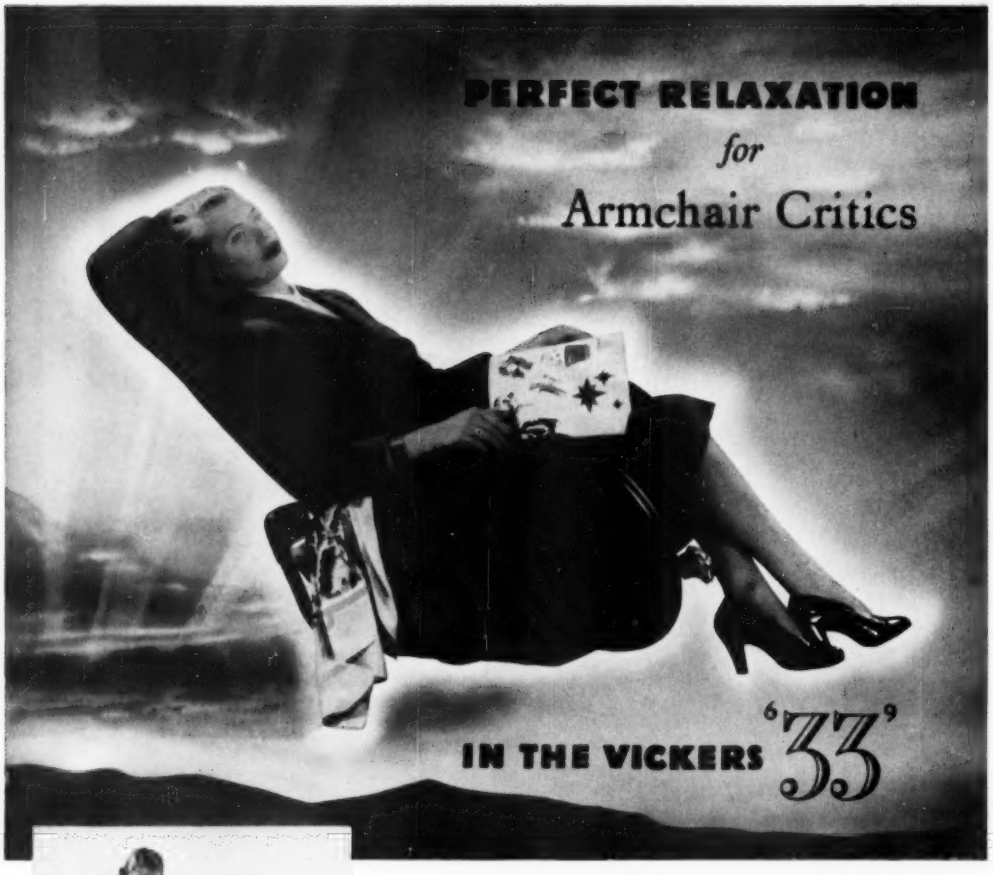
EXECUTIVE

CROP SPRAYING

SURVEYING

LANDING EQUIPMENT

S·55 & S·51 HELICOPTERS



Here is a Vickers aircraft chair providing luxury in every one of its 21 different positions, from upright to fully reclining. The shape and upholstery—the softest foamed rubber on spring and elastic bases—give perfect comfort. The chair can be used facing fore or aft and is particularly easy to instal, to detach for revised loading between flights and to maintain. Already the Vickers 33 is being used in B.O.A.C. 'Constellations', and in almost identical form in the 'Comet'. Full details will be sent on request.

VICKERS-ARMSTRONGS LIMITED

AIRCRAFT DIVISION · WEYBRIDGE · SURREY

AIRCRAFT INTELLIGENCE

HIGH WINGS are in the news this week. Uppermost of these new machines is the Max Holste 1521 Broussard, designed for tropical use as mentioned, right. The second (parasol-winged) machine, is a recent Japanese product. Made by the Tachihi Industrial Company, of Tokyo, it is known as the Type R-52 Trainer and is powered by a 130 h.p. Kamikaze II engine. Maximum and cruising speeds are given as 115 m.p.h. and 93 m.p.h., and the landing speed as 51 m.p.h.

Great Britain

Current Registrations. Only civil-registered machine of its type is G-ALGT, a Spitfire 14 (Griffon 65) which is owned by Rolls-Royce, Ltd., and based at Hucknall. A little-known registration is G-ALXP, which identifies a Firth two-seater helicopter; construction is not yet complete and no other details are given in the A.R.B. *Register*. The designation D.H. 106 Comet 2X is applied to the prototype Avon-Comet (G-ALYT) and its power units are named as four Rolls-Royce Avon 501s.

Civil Aircraft Analysis. A total of 1,203 civil aircraft hold current C.s of A.: of these 475 are used for airline, charter and taxi work; Government departments operate 27; 218 are trainers and 401 are for business or private purposes. The remaining 82 are classified under "aerial work" (50) and "miscellaneous" (32).

U.S.A.

Douglas A3D. This swept-wing carrier-borne attack aircraft, the first flight of which was made by George Jansen on October 28th, is claimed to be the most powerful ever designed for carrier operation. It can be used as a high-altitude bomber or low-level mine-layer, and can be adapted for photographic reconnaissance. The bomb bay is claimed to carry the largest type of bombs, torpedoes, or other munitions the U.S. Navy is expected to utilize in carrier-borne strike actions. Both the wing and tail fold for carrier stowage. The crew comprises pilot, pilot/bomb-aimer and gunner/navigator, who can change places in the air. A slide-type escape chute, similar to that used on the F3D Skyknight, forms the emergency exit. Comment by Mr. Ed Heinemann, Douglas engineering chief: "Though it is the Navy's largest bomber, the A3D is small and light in proportion to the missions it will accomplish. It is a result of the trend started by the Navy Bureau of Aeronautics and Douglas company of de-complicating combat planes."

American Fighter Canopies. Several well-known American fighters have recently appeared with modified cockpit canopies. Typical examples are the North American F-86D single-seat, rocket-armed, all-weather Sabre—which has a large canopy hinged at its rear end, and opening vertically—and the production Republic F-84F, which is likely to embody a heavily-reinforced hood hinging upwards on a parallel linkage, similar to that used on the experimental Republic XF-91. The F-84F will not, it appears, have wing-root intakes, except in the photo reconnaissance RF-84F version; the first batch are likely to have deep, straight-sided nose intakes. Another addition to the F-84F is an effective air brake—a Sabre-type twin-flap unit in the rear fuselage.

Canada

Avro Canada CF-100. According to *Avro Canada News* the prototype CF-100 Canuck 4 was flight-tested last month by Jan Zurakowski. The Mk 4, apparently, is a longer and more powerful variant, powered by Orenda 9s; increased armament and the latest electronic equipment is claimed for it, together with better performance.

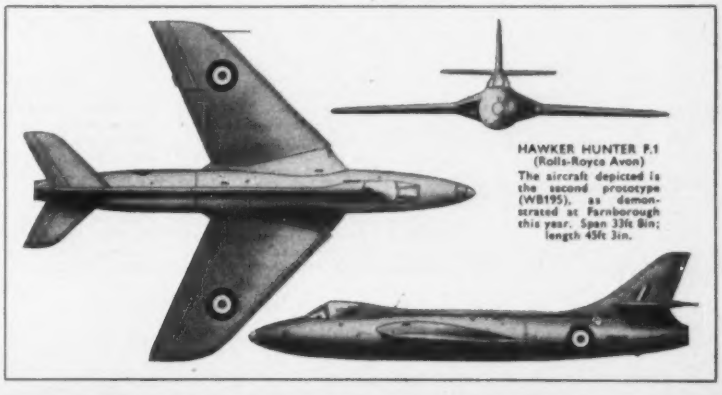
France

Max Holste 1521 Broussard. The first flight of this prototype, by Pierre Henry, took place on November 17th. Of all-metal construction, the Broussard was designed specifically for use in the tropics where ground installations are lacking, and its take-off and landing runs are quoted as 136 and 109yd respectively. A typical load is pilot, five passengers or 1,100-1,300 lb o freight. The engine is a P. and W. R-985 and the undercarriage is of Cessna patented type.

Matra Cantinieau. In its first four hours of flying this new French helicopter has not called for any modification. Designed for low initial cost, it is expected to go into quantity production very shortly. With a 135 h.p. Continental engine it will carry two stretchers in addition to the pilot.

Fauvel Av.36 Glider. On November 13th this new French glider was put through some severe tests during which it attained speeds of up to 112 m.p.h. and accelerations of 4g. The prototype has about 110hr flying to its credit and production aircraft are intended to be used either as trainers or as economical "performance" gliders, costing far less than half the price of current machines of the class. A two-seater model is being prepared.

Bréguet Super Deux-Ponts. In the light of experience acquired with their type 763 Deux-Ponts, and in collaboration with Air France and Air Algerie, the Bréguet company now proposes the Super Deux-Ponts which, while retaining the lines of the present machine, would be pressurized and would be fitted with Wright Turbo-Cyclone engines or—eventually—turboprops.



HAWKER HUNTER F.1 (Rolls-Royce Avon)
The aircraft depicted is the second prototype (WB195), as demonstrated at Farnborough this year. Span 33ft 8in; length 45ft 3in.

THE BATTLE of the BANGS

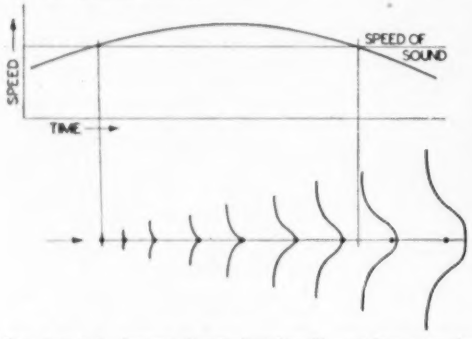
Round 4: A New Foray from the Home of the Hunter

THOUGH this controversy may sometimes be a little difficult for the non-mathematically-minded reader to follow, we again devote considerable space to it, for the "supersonic bang" phenomenon—if only by reason of its sudden incidence and the enormous public interest it has aroused—is probably the most spectacular and puzzling occurrence in the history of aerodynamics. This week we print a letter from J. W. Fozard, D.C.Ae., B.Sc.(Hons.), Grad.R.Ae.S., project engineer, Hawker Aircraft, Ltd., together with a further contribution from B. A. Hunn, B.Sc., senior mathematician to the same company. Mr. Fozard's thesis was extensively illustrated, and it has been necessary to omit the less essential diagrams.

From Mr. J. W. Fozard

I SHOULD like, if you will permit me, to contribute further to the sonic-bang controversy, Round 3 of which you published in your issue of November 21st.

I wish first of all to deal with W/C. Young's contribution of the above date, in which he postulates distorted wave-fronts occurring in supersonic flight, such that the wave-fronts lie along the Mach cone and continuously reinforce each other. If this explanation is correct then the distortion of the wave-fronts must occur for *any* Mach cone; i.e., at any supersonic Mach number including those just beyond unity. This being so, it must follow that for the case of a speed-time history such as that shown in Fig. 1 the formation of the "reinforced" wave-front itself must be a continuous process, which means in effect that only one bang could result from such a dive as Fig. 1 represents. Fig. 2 shows the size and position of the reinforced wave-front which would be caused by an aircraft following the speed-history of Fig. 1. Only one wave is formed and thus only one bang would be heard. But it is known that *two* bangs are heard to result from a dive such as Fig. 1 describes, and hence one must conclude that W/C. Young's ingenious explanation is, in general, incorrect.



Figs. 1 and 2. Sections through "reinforced" wave-front given by W/C. Young's theory and applied to the dive represented above. Note that only one continuous pressure-wave is formed. The dot represents the position of the aircraft relative to the wave.

However, I will support him if he will confine his theory to very low supersonic Mach numbers. I am firmly convinced that the bangs are formed only when the aircraft is travelling at the speed of sound—or, to be more exact, they are formed only when the speed lies within a very narrow speed-band which commences at a Mach number of unity and extends just beyond it. I am not prepared to define the exact upper limit of this band. Let it suffice to say that the band itself can be regarded as the range of speed for which the Mach cone can be considered as being plane.

Most readers will be familiar with the picture which shows the relative positions of the sound waves (or pressure disturbances) emitted by a body moving at exactly sonic speed, wherein the noises emitted by the body travel with it along its direction of motion for as long as it maintains sonic speed, and will thus reinforce and build up round the body. Now I am suggesting that this condition will obtain over a very small range of speeds extending beyond a Mach number of unity, because of the fact that pressure-waves of finite amplitude travel at a speed greater than that of sound. In other words, the process of reinforcement and the consequent building-up of a pressure-field, which we know occurs at M = 1.0, will also occur for speeds slightly greater than that of sound.

It is precisely this building-up of pressure which causes the bang; in fact, it is true to say the pressure-field *is* the bang, when it reaches our ears. Now, in the case of an aircraft the noises emitted are mechanical and aerodynamic—and in the term "aerodynamic noises" I include not only "pure" noises such as whistles and hisses but also pressure-disturbances caused by the body in its motion.

Thus for every single point on the aircraft which is emitting a

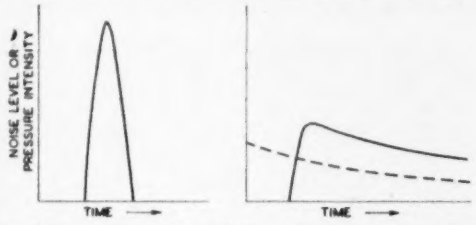


Fig. 3. Relative characteristics of (left) sonic bang and (right) the noises likely to result from a supersonic pass at low altitude. The dotted line indicates a low-speed pass by the same aircraft at the same height.

"noise" a pressure-wave will be formed when the aircraft is flying at speeds within the critical band; and over the whole machine these individual pressure-waves will coalesce and form a single pressure-field whose depth in the direction of motion will be approximately equal to the overall length of the aircraft.

Furthermore, the intensity of the pressure-field will build up with time as long as the speed of the aircraft remains within our specified limits. The argument has been advanced (by my colleague Mr. Hunn) that, because of this pressure field, it will be physically impossible to maintain steady flight at speeds at or very near that of sound. This amounts to the postulation that at such speeds the forces acting on the aircraft (lift, drag, etc.) are functions of time; but this, however, remains to be proved and will probably remain in doubt until such time as sonic speed is attainable in level flight.

I agree with Mr. Warren that the acceleration or retardation through sonic speed must be allowed for in explaining the formation of the bangs, but only so far as this determines the time that

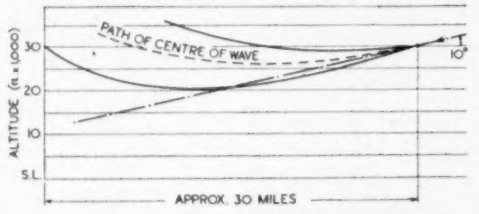


Fig. 4. Path of bang generated in a 10 deg dive at 30,000ft. (Not to scale; calculated for standard atmospheric conditions.)

the aircraft has spent in the critical speed band, and hence the intensity of the resulting bang.

Bangs will not result from sustained supersonic flight at Mach numbers beyond the upper limit of the critical region, for the simple reason that there is no build-up of pressure with time at any point on or within the Mach cone. For any point on the Mach cone, there is only one position on the flight-path from which noises or pressure disturbances emitted by the aircraft would reach such a point at the instant being considered. Furthermore, at any point within the Mach cone, pressure disturbances and noise will arrive from two distinct points on the flight-path of the aircraft. So, although the Mach cone may be a discontinuity of pressure it will certainly not have the same physical characteristics as the sonic bang. It also follows that an observer situated at a

point within the cone will experience noise of approximately twice the intensity that would be experienced at the same point, if the aircraft were to fly along the same path at a low subsonic speed. Fig. 3 gives the relative proportions of a sonic bang and the noise likely to be experienced when supersonic flight at low altitude becomes possible.

Any number of bangs can be generated in a single dive, as has already been pointed out by Mr. Yates and Mr. Hunn. I am reliably informed that a three-bang dive has actually occurred.

[*Mr. Fozard provides diagrams—not included here—illustrating, first, a "three-bang" case in which the aircraft "touches" Mach* 1, *decelerates, then passes Mach* 1 *and finally decelerates again; and, secondly, a "five-bang" history which, he suggests, might be produced by similar repetitions.*—Ed.]

Having put my point of view on the subject of how the bangs are formed, I should now like to deal with the mechanism of their propagation through the atmosphere. This aspect has been largely ignored in all previous articles on the subject, and since I consider it important I will deal with it in some detail.

Due to the increase of temperature (and hence an increase in the speed of sound) with decrease of altitude, the pressure-wave will follow a curved path which is found to approximate very closely to part of a circle. Thus if we consider a bang being generated in the atmosphere below the tropopause (36,090ft) it will initially follow the path along which the aircraft has been flying whilst the bang was being generated but, due to atmospheric refraction, it will subsequently curve away so that it tends to become tangential to the ground. In other words, if the aircraft is diving in a straight line towards a specific point on the ground the pressure-wave will overshoot the pilot's "aiming point."

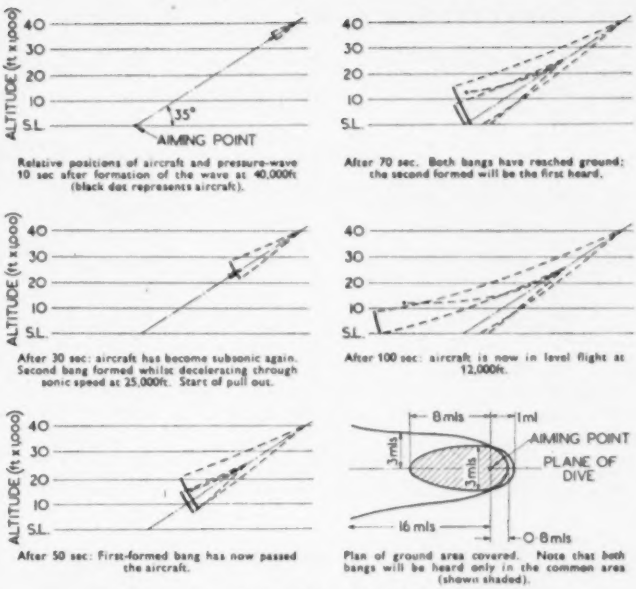

ALTITUDE (ft x 1,000)
40
30
20
10
S.L.
35°
AIMING POINT
Relative positions of aircraft and pressure-wave 10 sec after formation of the wave at 40,000ft (black dot represents aircraft).
After 70 sec. Both bangs have reached ground; the second formed will be the first heard.
After 30 sec: aircraft has become subsonic again. Second bang formed whilst decelerating through sonic speed at 25,000ft. Start of pull out.
After 100 sec: aircraft is now in level flight at 12,000ft.
After 50 sec: First-formed bang has now passed the aircraft.
8 mls
1 ml
3 mls
3 mls
AIMING POINT
PLANE OF DIVE
16 mls
8 mls
Plan of ground area covered. Note that both bangs will be heard only in the common area (shown shaded).

Fig. 5. Time-history (reading downwards) of a typical two-bang dive.

During the time that it is travelling earthwards, the pressure-wave will, of course, expand, the semi-angle of expansion being of the order 6 deg to 8 deg. The pressure-wave will also suffer some atmospheric attenuation; the indications are, however, that the actual degree of attenuation is small over the distances involved. We can visualize the whole phenomenon more clearly if we imagine that during its downward path the pressure-wave is contained within a horn-shaped volume, the semi-angle of the horn being about 8 deg and the curvature of the axis of the horn being a function of the altitude and initial direction of propagation of the wave.

It should be noted here that the curved path of the pressure-wave is entirely due to the lapse of temperature with height. In the stratosphere, where the lapse-rate is zero (i.e., constant temperature) the pressure-waves will follow straight-line paths along their initial direction of propagation. In the troposphere (below 36,000ft) the actual degree of curvature is dependent on the lapse-rate. In stable meteorological conditions, which correspond to a low lapse-rate, the path will be less curved than in unstable atmospheric conditions, which correspond to a high lapse-rate.

Under normal atmospheric conditions (excluding inversions and the like) the only stable path for one of these pressure-waves is vertically upwards, and in this case the path would be a straight line. A pressure-wave can also travel in a straight line vertically downwards in the troposphere, but this condition is negatively stable and any small disturbance would cause the wave to curve away and attempt to attain a vertically upward (stable) path.

Fig. 4 shows three calculated paths of a pressure-wave (i.e. a "bang") which is generated at 30,000ft in the standard atmosphere. The curvature of the path is greatest for shallow angles of dive, and the ground area covered by the wave is much elongated in the plane of the dive, although in the case illustrated, the angle of dive is such that the wave will not contact the ground at any point along its path. I must stress that it is very difficult to define the ground area covered because the edges of the wave are perforce very vague. The character of the noise heard within the ground area will change according to the position of the observer within this area. At the centre, in the plane of the aircraft's dive, the noise heard will be a sharp crack or "bang"; further out from this point it will be a "boom" and this will decrease in intensity and become more of a "rumble" at still greater distances. The dimensions quoted cover the area in which a "bang" type of noise is likely to be heard, but it is important that they should be regarded as no more than an indication of the distances involved.

Fig. 5 shows the paths of the pressure-waves generated in a 35 deg dive during which the aircraft accelerates through the speed of sound at 40,000ft and decelerates through sonic speed at 25,000ft. If we assume that the aircraft travels at a *mean* Mach number of 1.03 between 40,000ft and 25,000ft then the time interval between the bangs as heard on the ground would be approximately 0.75 sec—the first bang heard being the one formed at the lower altitude. If the above dive could be carried out at a *mean* Mach number of 1.3 then the time separating the bangs would be approximately 6 sec.

In order further to confound Mr. Warren, whose "sonic-speed-towards-the-observer" explanation you printed in your October 17th issue, I should like to point out that, as far as the Hunter is concerned, the dives from which bangs result are straight dives and do not by any means resemble the dog's-leg type of curve shown in his pictures.

In conclusion, I should like to state that the views expressed in this article are entirely my own and that I am indebted to Mr. S. Camm, director and chief designer of Hawker Aircraft, Ltd., for permission to publish them.

Kingston-on-Thames. J. W. FOZARD.

From Mr. B. A. Hunn

MAY I beg your indulgence once more in coming out of my corner for the next round?

It seems to me that the best way of answering Mr. Warren's second letter is to discuss the implication of his theory. Since he argues that the bang is heard when the aircraft's velocity relative to a stationary observer in stationary air is sonic, then the aircraft itself must be travelling at supersonic or at least sonic velocity. It follows that the bang is heard when the envelope (i.e., shock-front) of the aerodynamic disturbances passes the observer. Let us now consider the generation of a conical envelope as in Fig. 1, overleaf. If at the time t, the aircraft is at A, having generated, amongst others, at previous times t_2 and t_1 the spherical disturbances centred at B and C whose common tangents like P_1Q_1 and P_2Q_2 are generators of the cone, these generators will be moving normally to themselves with the velocity of sound a and elongating at a rate $a\sqrt{M^2-1}$ where M is the Mach number of the aircraft. The particular segments PQ associated with these spheres are of constant length, but they will be moving away from the vertex of the cone with the velocity $a\sqrt{M^2-1}$.

Now, clearly, the envelope of disturbances associated with subsonic flight will not exist. But with sonic flight the envelope is a singular point which we may regard as the source from which the

THE BATTLE OF THE BANGS . . .

supersonic envelopes originate. If, now, an aircraft in a dive accelerates to a supersonic speed and then decelerates to a subsonic speed the envelope will be of a curved type as shown in Fig. 2. The shape shown corresponds to the instant at which the aircraft

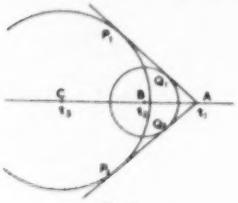


Fig. 1.

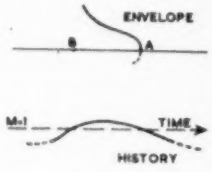


Fig. 2.

is at A. The points A and B are the singular-point parts of the envelope. Now points of this envelope move with a velocity parallel to the flight path of magnitude $\frac{a^2}{V}$ where V is the speed at the instant at which these points on the envelope are generated.

Now it is clear that the envelope changes in time, and this change consists of movements of corresponding points along the surface. In particular, parts of the envelope which are convex outwards remain so while parts which are concave outwards become convex. The ultimate shape taken up by a generally curved envelope will resemble a series of concentric hyperbolæ whose common asymptotes are prescribed by the maximum Mach number achieved. The number of distinct curves will be the number of times the aircraft passes through any given supersonic speed. This, therefore, must be an even number and in the case of the simple flight history envisaged in Fig. 2, the ultimate envelope will consist of only two discrete surfaces.

Now Mr. Warren's criticism of my theory was that if the aircraft performed the above type of flight history it could not explain a triple bang. My reply is that, by virtue of the more detailed examination above and the knowledge that our own supersonic dives are straight, I conclude that his theory cannot do so either. I will go farther and say that his theory can never explain an odd number of bangs, whereas my sonic theory can do so if we permit the aircraft in the course of its dive to touch sonic speed three times without passing through the "barrier" the second time.

Turning to W/C. Young, I cannot see how the question of pitch can be introduced in talking of a pressure-field generated by the passage of the aircraft through the air. This field is non-periodic, being a single wave by nature, excluding turbulence. As to the number of circles or spheres passing through the singular point in a finite time I hope I have made it clear that they were circles generated over infinitesimal increments in time. If the increments were of a finite magnitude then there would exist only a finite number generated in a given time-interval. However, in the limiting process this number becomes indefinitely large. Thus, any use of the word infinite can be taken as mathematical (as opposed to poetic) licence.

Kingston-on-Thames. B. A. HUNN.

DEFENCE EXERCISES AND REALITY

AFTER an air-defence exercise a year or two ago, a young fighter pilot was very elated when told he was adjudged from his camera-gun films to have shot down an "enemy" bomber, one of a large formation of Superfortresses. Some days later he left an office more thoughtfully—having learned that his "kill" could no longer be allowed: correlation of the claims of both bombers and fighters showed he had twice been shot down by the guns of the bombers before delivering his decisive attack.

At least twice, in *Flight's* recent descriptions of Exercise Ardent, the Superfortress was referred to as being an easy target. Watching from the ground (usually, in the writer's case, with × 20 binoculars), exercise-attacks on these bombers appear very effective—*if* the bomber had no defensive armament. Some pilots press in very close until they could hardly fail to bring the bomber down; but unless the turrets were out of action the defending gunners would have excellent opportunities on the breakaway when the fighters show their ventral tanks at close range.

When dealing not with a single aircraft but a formation, it is not enough to put the defence of your chosen target out of action; the B-17s and B-24s proved that during the war, and a B-29 gunner who fought Migs in Korea has said, "They're fast, but we can still hit 'em; you don't get such a long squirt, but their firing time is that much shorter too!" Now the Migs go duck-shooting, and while such tactics are bound to bring some bombers down, the threat of the atomic bomb makes 100-per-cent. success imperative. If the Russians sent huge formations of Tu-4s with escort, each of our fighter pilots might find that he would have to bring down two or three bombers. Even if that were possible, it would take much time and ammunition; and even though the Tu-4's armament may be simpler and less effective than that of the B-29, it would still be no help.

Thus, though some of the enemy "bludgeon" would get through, there might be a solution to the problem in the employment of a monitoring missile (a development of the airborne radiation-detector), which the first intercepters could fire amongst a particular formation in order to determine whether an atomic bomb was being carried, and thus establish priority for attack.

Watching, as a layman, the "Ardent" scrambles from Waterbeach, Oakington, and Duxford, and the air battles which came that way, one was depressed—despite the obvious efficiency—by the utter inadequacy of it all; one wondered whether fighter aircraft, however efficient they and their pilots may be, will ever be able to defend this island. The whole conception of the exercise, in fact, seemed unrealistic; either we hold most of the Continent and can base our fighters in Denmark and Germany, and intercept enemy raiders there (clearing up, over France and the North Sea, any stragglers that may get through) or we are within range of guided missiles of the V.2 type, used instead of bombers.

How, then, can we defend our islands? A standing patrol of large airships, flying at about 25,000ft over the North Sea, each with its own radar station (what a range from 25,000ft!) and a very large supply of ramjet-guided missiles with ranges of upwards of 50 miles? As well as killing approaching bombers, such missiles could destroy hostile fighters, thus defending the airships.

But will the guided missile really be a more lethal bomber-destroyer than the gun? The fighter attacks the bomber and the bomber shoots at the fighter. When the time comes for the fighter to shoot missiles, the bomber will fire a missile at the fighter's missile to defend itself—and perhaps one at the fighter to bring that down. While this goes on the flight engineers use their receiving detectors to discover the frequency used to guide the enemy missile. Then the fighter fires two more missiles, one to defend itself, the other to defend its original missile from the bomber's missiles. It is then the bomber's turn again, until the sky is full of strings of missiles chasing one another, and the respective crews have found the frequencies used, and are each trying to control the other's missiles; and when a missile nears an aircraft the latter emits a pulse of the proximity-fuse frequency and prematurely explodes it.

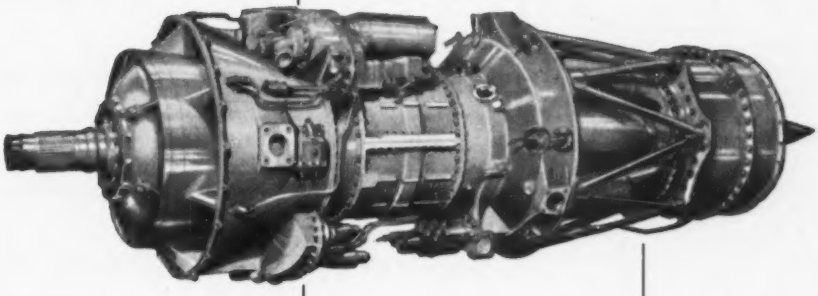
PEDANTICA.

THE TEACHERS' DILEMMA

THE present shortage of technicians in Britain's aircraft industry, and the reasons for this shortage, have been discussed at length in recent issues of *Flight*. In particular, the article entitled "The Technician's Dilemma" (November 14th) has provoked much interest, expressed in our correspondence columns. The writer claimed that skilled men are leaving British aeronautics for other industries, or for Canada and the U.S.A., due to lack of adequate payment and appreciation.

A recent article in the *Daily Mail* has called attention to a similar state of affairs in the teaching profession. The lack of a differential pay-structure for specialist services, it is claimed by the author (a headmaster), has caused a serious shortage of advanced-science teachers. This in turn will inevitably reduce the number of students taking up science and engineering subjects on leaving school, with adverse effects on science and engineering (including aeronautics), and again on the teaching profession.

The writer claimed that as a consequence of the 1944 Education Act, many schools had been forced to drop the advanced teaching of mathematics or a science, simply through the lack of people to teach these subjects. By April, 1950, there were 48 such schools and 193 posts unfilled. The Oxford University Appointments Board had reported that, from 1945-49, out of 897 science graduates, only 49 became teachers, and 8 of these soon left; in 1951, no chemists entered the teaching profession. In Great Britain as a whole, by last August, 273 unfilled science vacancies were reported, and one-fifth of the positions which were filled were held by people only partly qualified.



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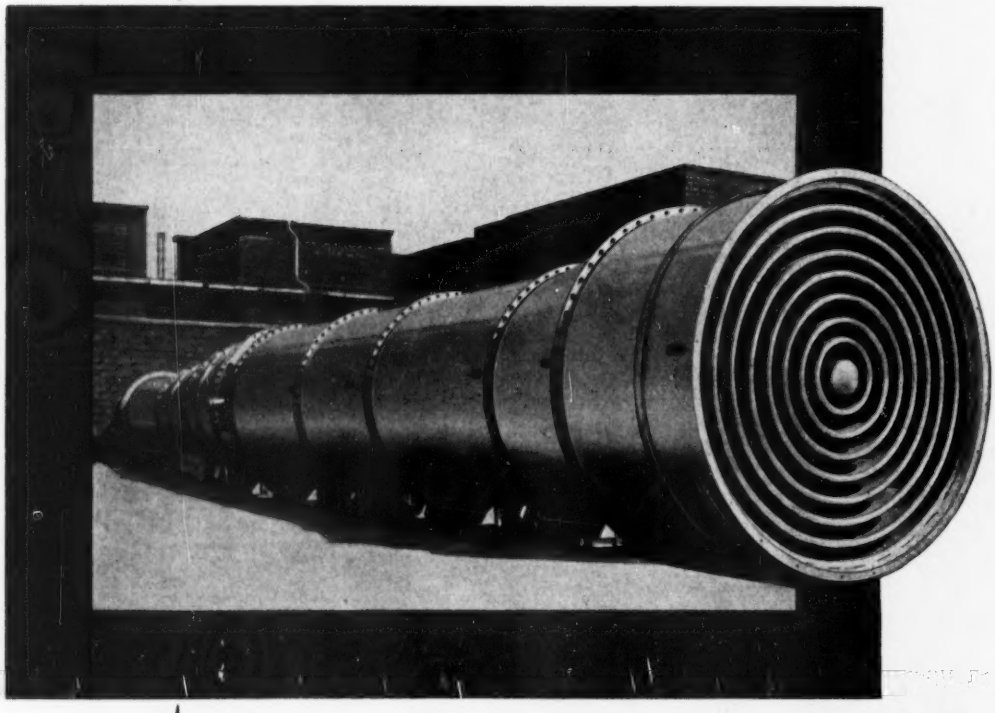

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Our American Correspondent Reports . . .

TO see an ordinary American presidential election (if there ever is an "ordinary" one) is a remarkable enough experience, but to have been in the States during this last four months puts one into a special and privileged class, the observer-membership of which carries with it a permanent reflex action whenever politics are mentioned.

Quite understandably, election news crowded pretty well everything off the front pages, and throughout the campaign aviation was left more or less alone and was hardly used anywhere as a political subject. In consequence, a lull in aviation news set in about mid-October, and—with the exception of the Comet purchase by PanAm—remained until mid-November. In one case at least this was carefully planned, for the re-opening of Newark Airport to normal commercial operation was timed for after November 4th.

Not that this re-opening was insignificant or unimportant, but if it had occurred earlier it could conceivably have been used as a talking-point against the current (but soon to be relieved) Administration. It was also an expensive opening, inasmuch as the new runway, designed to eliminate all landings and take-offs over the populated areas which suffered so severely from the three crashes during December and January last, cost some $9m.

Additionally, and in order to meet the severe resistance put up by the residents of Elizabeth and other local areas to any reopening at all, some very strict regulations have been introduced. It is now fully realised that this problem of noise (and, to a lesser extent, danger) around the larger American airports is a very serious one indeed, and could, in extreme circumstances, cause the closing of all New York's major terminals. One authority said recently that he believed that unless an overall programme of educating the local airport residents all over the country, plus most careful control of the traffic pattern, plus improved silencing, was introduced, the jet age in aviation here might be seriously delayed. As the first commercial turbine aircraft to fly in and out of United States airports are likely to be British-built, this warning is important.

* * *

THE first flight of the Super-Connie 1049C is another bit of current news. Some 69 of these aircraft are said to be on order, the biggest buyers being: Eastern Airlines, 16; K.L.M., 13; Air France, 10; T.C.A., 8; and Seaboard and Western, 5. The Wright compound engines give 3,250 h.p. for take-off and the aircraft are expected to cruise at between 330 and 340 m.p.h. Passenger-capacity will be 59 first-class or between 90 and 95 tourist. Deliveries are due to start next January.

While on the subject of orders, we may add that Pan American have recently asked for five more DC-6Bs, which will give them an expected fleet of 45 of these aircraft, with some 18 already in service. Douglas also have orders for some 50 DC-7s. This latter, said to be a $1¼m. aircraft (or more by the time it is delivered, for not even the new Administration can stop the price of aircraft going up), is also fitted with Wright compound engines. It should cruise at 350 T.A.S., or better, at 20,000ft and can carry 65 first-class passengers or 95 tourists. The wing loading will be in the region of 84 lb/sq ft at take-off and a 6,400ft runway will be needed. An interesting feature will be the stressing of the undercarriage for use as an air brake to increase the rate of descent.

* * *

TO those who believe that the turbine-engined airliner is not only right here, but is also a "must" for any operator who wants to stay in the business, orders for large piston-engined machines may look strange. Admittedly, these new aircraft will be very economical, and will be needed over the next five years until production of jet-engined commercial aircraft gets into its stride. But there is perhaps another reason why the American operators will, in the future, be very glad of them, and of their high-density seating capacity. During the last 18 months the increase in U.S. domestic tourist traffic has been most remarkable. Today there is hardly an operator here who doesn't believe that his future livelihood depends on this sort of business. They will tell you that the first-class passenger will no longer be their bread and butter, and to prepare for this regime more and more large aircraft are being converted for "air-coach" travel.

Obviously, of course, the luxury class will not disappear. The businessman's expense-account (that modern American substitute for class distinction) will see to that. And for such services the jet will be available in limited numbers. But the bulk of the people will want to travel as cheaply as they can, using high-density versions of today's luxury airliners. They will, in fact, get pretty well the same standards of comfort and stage-length and speed that we get today. Thus the compound-engined Constellations and the DC-7s which are just coming into service now will probably have a long and profitable life ahead of them—until they are challenged by the turboprop.

* * *

SOMEWHERE, some time, someone is going to make a good thing out of a DC-3 replacement. In the United States alone there is a big demand for such a type. But so far the approach has been a timid one and designers seem to have been cramped by too much discussion as to what, exactly, is wanted.

It's not always a good thing to ask aviation people what they want. Experience has shown that there are often as many answers as there are people asked. The manufacturers who have been successful in selling aircraft in the past were those who themselves decided—with the aid of their own experience and a private crystal ball—what they should build. Once such an aircraft was produced, and provided it was a reasonably good one, it created its own market. Very few efficient aircraft have flopped, and the demand for them has nearly always exceeded the supply. But this method of deciding what to do (rather than by relying too heavily on such things as market surveys or polls of possible users) doesn't necessarily mean that the customer is always wrong. It merely means that each customer wants something a bit different from the other fellow, because of some particular operating problem; and a good all-round-efficient aeroplane allows him sufficient compromise to make its purchase worthwhile. All of which is by way of an introduction to some observations on the Canadair CL 21.*

At the moment Canadair appear to be perched on the market-survey fence, undecided as to what to do. Having introduced both verbally and in specification form a possible DC-3 replacement, they are sitting tight and waiting for the reaction of the operators and their own survey personnel. How long it will be before the fence becomes too uncomfortable it is impossible to say. Actually, and from such operators as have discussed the machine, the reaction has been more or less favourable, despite the fact that this is Canadair's first production venture of a complete machine of their own. Personally, one wishes that a machine of similar specification was now being built in England to round-out our own picture. One or two critics have said that they would have preferred a four-engined type; and others, looking further ahead, have wished it were a turboprop aircraft.

As yet unnamed, the CL 21 is to be a high-wing, twin-engined transport with a pressurized cabin and seating capacity for 32 passengers. All-up weight is given as 32,500 lb and the engines would be Wright Cyclones, although there are rumours that an alternative British-made power plant might be fitted to take care of the sterling areas. The general arrangement shows a somewhat stubby-looking machine of comparatively high aspect-ratio with waist-level cargo doors. Twin nosewheels and twin mainwheels give a ground clear-

* *A preliminary description and drawings of the CL 21 appeared in "Flight" of June 13th last, and on November 14th we quoted a number of performance estimates*—Ed.

Our American Correspondent Reports . . .

clearance of only 1ft 6in (which hardly seems enough for "out in the blue" operation). Cabin pressurization will be equivalent to a flight altitude of 7,500ft., and the internal layout allows two rows of 16 seats on each side (eight pairs to a side) and a 17½-in aisle. A brief specification is given in the accompanying table.

Particular attention has been paid to economy of operation over short routes, for which an operating altitude of 3,000ft has been assumed. For longer distances the height is increased: 5,000ft is assumed for stages of between 100 and 300 miles, and 15,000ft on trunk routes of 500 miles or more. High rates of descent are envisaged at all times.

CANADAIR CL 21
(Two Wright Cyclone 9HE, approx. 1,500 h.p. each for take-off).

All-up weight	32,500 lb
Landing weight	32,500 lb
Empty weight	21,401 lb
Wing area	950 sq ft
Wing loading	34.2 lb/sq ft
Take-off minimum runway length	3,500 ft at s.l.
Landing minimum runway length	3,500 ft at s.l.
Stalling speed (with landing-flap setting)	77 m.p.h.
Cruising speeds:	
At max. cont. power at 12,600ft	276 m.p.h.
At 60 per cent power at 15,000ft	237 m.p.h.
At 60 per cent power at 5,000ft	216 m.p.h.
Max. range (full standard tanks, 4,690 lb payload, no allowances)	1,900 miles
Passenger capacity	32
Cargo capacity	330 cu ft
Volumetric-capacity payload	7,920 lb
Weight-limited payload	8,417 lb
Usable fuel	790 U.S. gallons

A WELL-MERITED HONOUR

WITH a very few exceptions, American reaction to British jet-transport progress has been a generous one, and now comes yet another demonstration. The Daniel Guggenheim Medal Board has decided that the 1952 Guggenheim Medal shall go to Sir Geoffrey de Havilland, in recognition of his "forty years of pioneering in military and commercial aircraft and the development of long-range jet transport."

Sir Geoffrey de Havilland, C.B.E., A.F.C., R.D.I., F.R.Ae.S., Hon. F.I.A.S.

The Board was composed this year of 25 persons who were either past winners of this award, residing within the United States, or representatives of the American Society of Mechanical Engineers, the Institute of Aeronautical Sciences and the Society of Automotive Engineers, together with a representative from England, Major Frank Halford. Sir Geoffrey received the unanimous vote and was thereupon invited to attend the annual meeting of the A.S.M.E. (held in New York, November 30th-December 5th) to receive the award.

The Daniel Guggenheim Medal is one of the most coveted aviation awards of the United States; it was established in 1928 by the Daniel Guggenheim Fund for the Promotion of Aeronautics and is given for notable achievement in the advancement of aeronautics.

On hearing of the Board's decision, Sir Geoffrey expressed his profound appreciation; he referred especially to the honour done to all the members of the de Havilland companies as well as to himself, and acknowledged the award to be "a notable mark of recognition of the work accomplished by all around him."

Sir Geoffrey is, we learn, greatly touched by this gesture from across the Atlantic, and recalls, as if only a few years ago, how it was the example of the Wright brothers' first flights at Kitty Hawk in 1903 which filled him with an overwhelming desire to fly and led him on to his own ventures. These began in 1908, when he built a biplane, which unluckily crashed on its first flight; in the following year he built another, and on this, in 1910, he taught himself to fly.

WIND-TUNNEL MEASUREMENTS

THE development of the latest automatic wind-tunnel balance in use at the Blackburn and General Aircraft factory at Brough was described by two of the company's wind-tunnel specialists at the Royal Aeronautical Society's section lecture on Thursday, November 20th. Mr. L. E. Leavy, A.F.R.Ae.S., and Mr. C. J. Saunders were speaking on *The Design of a Wind-Tunnel Balance*, and chairman for the evening was Mr. N. E. Rowe, C.B.E., D.I.C., B.Sc., A.C.G.I., F.R.Ae.S.

Mr. Leavy began by mentioning the past lack of steady development in balance design: many different types had been evolved, normally on an *ad hoc* basis. At Blackburn's, it had been decided to design and build their own six-component installation (for use with the 7ft by 5ft general-purpose tunnel), rather than place an outside contract—a decision which had been fully justified. The balance was based on the "virtual centre" principle, and incorporated weigh-beams, the poise-weights of which were automatically moved by leadscrews. The weigh-beam tip, when in equilibrium, floated between two pairs of adjustable electrical contacts; in oscillation, contact was made, and a Selsyn transmitter coupled to the leadscrew operated the counter on the control console.

Weigh-beam indicators, forming an inductance bridge, were used as a further indication of central position. A plunger attached to the beam moved in the hollow core inside two coils, and the swings of the beam were consequently reproduced in the swings of a galvanometer needle. Variable frictionless damping was obtained magnetically, using a moving coil, a change in the degree of damping being effected by a rheostat in the primary circuit. As the overhead-balance system was inherently stable, destabilizing weights in addition to the counterpoise weights were needed to increase sensitivity. The speaker concluded by outlining the electrical system used and expressing the firm's satisfaction at the results obtained with the balance.

Mr. Saunders, who is in charge of the firm's research workshops, then introduced a colour film showing the balance in operation. Constructional details and test run method were clearly shown. A period of questions followed, during which the question of accuracy and the relative merits of the main types of balance were discussed at length; afterwards, specimens of various units used in the balance were on view to the audience.

S.M.A.E. PARTY

FOR thirty years the Society of Model Aeronautical Engineers has, by dispensation from the Royal Aero Club, been the governing body for British model flying, and today no fewer than 480 clubs are affiliated under its control.

This, perhaps, explains why, at the S.M.A.E. annual dinner, prize-giving and dance, held in London on November 22nd, the long top table was lined from end to end with silver trophies—the most impressive collection of what is irreverently called "ironmongery" that we remember having seen at any function.

The evening was also notable for a great mingling of ages; the pioneers of the modelling movement, men in their fifties and sixties, were enjoying reunions in company with young enthusiasts who had come from all parts of the country to collect well-deserved prizes.

During the past season the Society's teams have done particularly well in international events, their successes including the control-line championship (flown in Belgium) for the second year in succession, the power championship (in Switzerland) and the F.N.A. Cup in Italy. Next summer the S.M.A.E. itself will hold an international championship in this country.

Speakers at the dinner included Mr. M. R. Knight, F.S.M.A.E., whom older readers will remember as a pre-war contributor of model-aircraft descriptions; Mr. A. F. Houlberg, A.F.R.Ae.S., S.M.A.E. chairman, and president of the F.A.I. Models Commission; Col. R. Yates, S.M.A.E. Council delegate, S.E. Area; and Dr. R. W. S. Cheetham, who is vice-president of the South African division of the Royal Aero Club; a specialist in aviation medicine, he is at present on an extended visit to this country. The M.C.A. was represented by Mr. L. C. Nash, O.B.E., whose section at the Ministry deals with private flying and club policy-matters.

Guest of honour was A. Cdre. Whitney Straight, C.B.E., M.C., D.F.C., deputy chairman of B.O.A.C. (he presented a most original trophy, illustrated in these pages three weeks ago), and Lady Daphne Straight gave away the prizes—a quite formidable task, performed with grace and charm. Mr. Max Coote, of Ripmax, Ltd., acted indefatigably as M.C. and general organizer. He is the S.M.A.E.'s technical secretary.

The venue, incidentally, was the Horse Shoe Hotel, in Tottenham Court Road, where the *hôtelier*, Mr. John Appi, is himself a keen supporter of the movement; we were permitted a look at his workshop where some superbly built radio-controlled model aircraft and boats were in various stages of completion.

super priority

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Two Sapphires power the Gloster Javelin all-weather fighter

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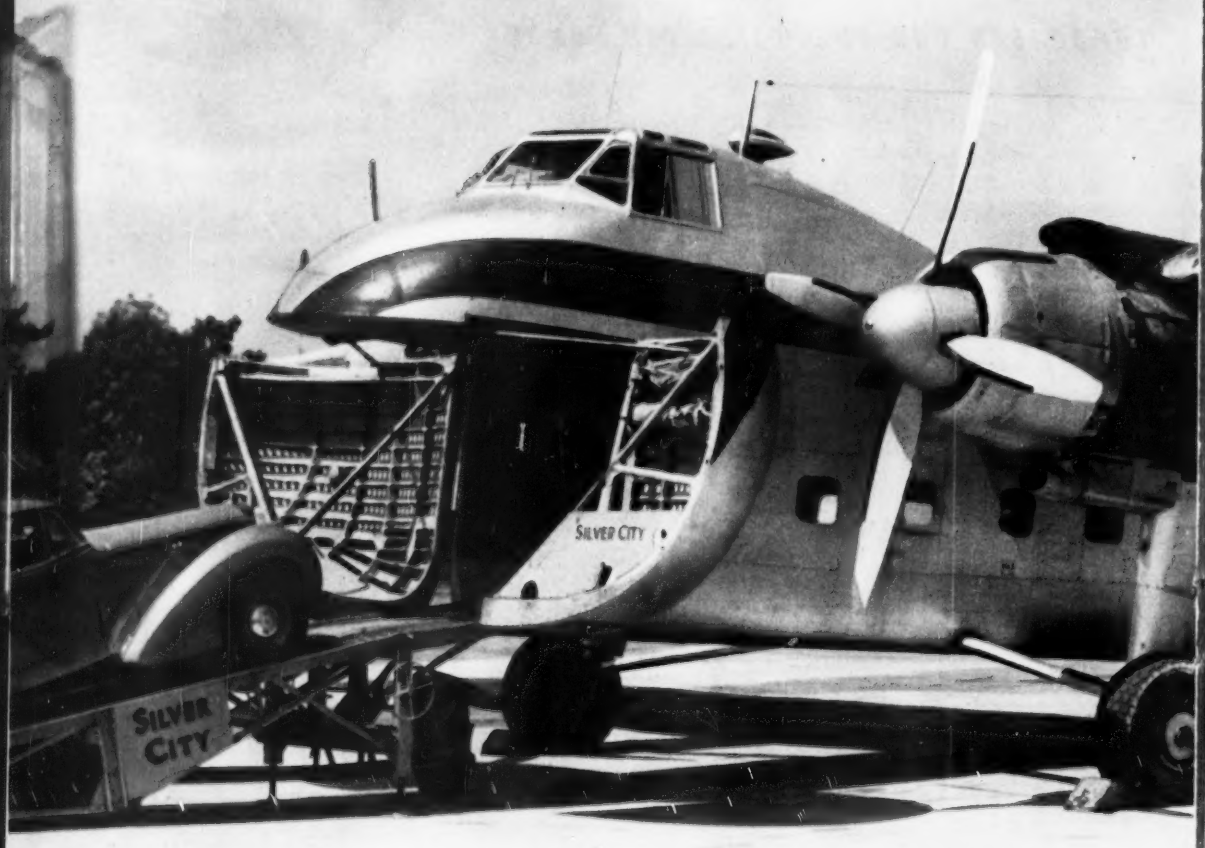


DE HAVILLAND PROPELLERS

DH PROPELLERS

IN *the freezing attenuated air of the sub-stratosphere flies a Boeing B-47B six-jet bomber of the U.S.A.F., seen through the massive clear-vision canopy of a sister aircraft, with the Lombard-helmeted co-pilot half-closing his eyes against the glare. Below, with the* 19,324ft *Mount Kilimanjaro beyond, flies an English Electric Canberra B.2, which is undergoing tropical trials in Kenya. The Canberra's ceiling is perhaps two-and-a-half times the height of the great African peak.*

FROZEN HEIGHTS

STRATOFORTRESS

VERY little has yet been published about the Boeing B-52 heavy bomber, and it is not likely that much additional information on this aircraft will be released for many months to come. But so remarkable is this great bomber that unusual interest is excited by a study of photographs of its exterior. Here we offer some random conjectures prompted by such a study, prefaced by an account of the type's design-history.

MANY far-reaching decisions resulted from the meeting in August, 1941, between Mr. Franklin D. Roosevelt and Mr. Winston Churchill. Not the least of these was the call for design studies of a bomber which could attack Germany from the North American continent, for it then appeared possible that British resistance might be forced to cease, both in the British Isles and in North Africa.

The enormity of even the preparation of a mere design-study was by no means lost to the American engineers of eleven years ago and, although several companies attempted to produce a design with the range required, all agreed that their limited experience could not result in anything but a very large and slow aircraft. Contracts were, nevertheless, placed in the autumn of 1941, as a result of which the Convair B-36 still forms the long-range weapon of the U.S.A.F. Strategic Air Command.

The Boeing Airplane Company had submitted proposals, but they were not sorry when the contract went to a rival firm, for the Boeing B-17 was in full production, and almost the entire energies of their design staff were directed towards the development of the large, and complex, B-29. A new element was also coming into the picture—jet propulsion.

In fact, in 1945—before the XB-36 had flown—Boeing began actual design work on the B-47 six-jet bomber. This most advanced design was "frozen" at a time when only 5,000 lb. thrust could be obtained from a turbojet, and when high-speed aerodynamic knowledge was much more limited than today; but it has, nevertheless, remained the fastest bomber until the present time. On the other hand, its range was never intended to place it in the inter-continental class; that was reserved for a bigger bomber yet to come.

By January, 1946, the U.S. Air Force had marshalled its thoughts sufficiently to produce a set of basic requirements for the new long-range bomber, and the following month it invited aircraft firms to submit proposals for preliminary studies. Of the few submitted, the Boeing project came nearest to the requirement and the company were authorized to proceed with engineering study and preliminary design work. What Boeing had sketched was a good-looking heavy bomber known as Type 462. With a wing span of 221ft. and a crew of ten, it was to be powered with six of the big Wright T-35 Typhoon turboprops of 5,500 h.p. each, then about to commence bench running. But the design was still lacking in range.

The principal cause of this fault was the lack of a really good power plant; contributory factors were the size of the bomb bay, and the weight of the complex armament system envisaged. So the Boeing design staff tried variations in wing area from one limit to the other, as well as other less fundamental alterations. At the same time, the Wright corporation was preparing a development of the T-35 designed to give 8,900 h.p., thus allowing the number of power plants to be reduced to four and reducing the empty weight by some 8,500 lb. But the specific fuel consumption was still not up to the desired figure, and this was again reflected in an insufficient range.

A larger basic design was then worked around the improved turboprop, and analysis showed that this would meet the range requirement, and would also be faster than similar aircraft then under construction. But Boeing felt that it was not as fast as a bomber would need to be; in fact, they considered the design had become altogether too massive and cumbersome. Only one solution presented itself; the strenuous development of more efficient gas turbine power units.

During the next two years such development actually took place; B-47 service tests were initiated during this period, and the type proved itself a bomber of outstanding performance—albeit with some penalty in ease of handling. Particularly significant were the facts that specific fuel consumptions were being reduced and that flight refuelling was gradually being adopted as a standard procedure. During the summer of 1948, therefore, the company began to study a long-range *turbojet* bomber—even though the design of the turboprop aircraft was rapidly approaching the "freezing" point, with a contract for two prototypes already signed.

The further the turbojet investigation went, the more attractive this aircraft appeared. But the turboprop bomber was still the officially approved study, and in October, 1948, twelve Boeing engineers went to the headquarters of the U.S.A.F. Air Material Command in Dayton, Ohio. They were prepared, first, to demonstrate that their turboprop study would, when built, be able to accomplish the desired type of mission and, secondly, that the airframe would probably be ready before a workable turboprop unit could be developed.

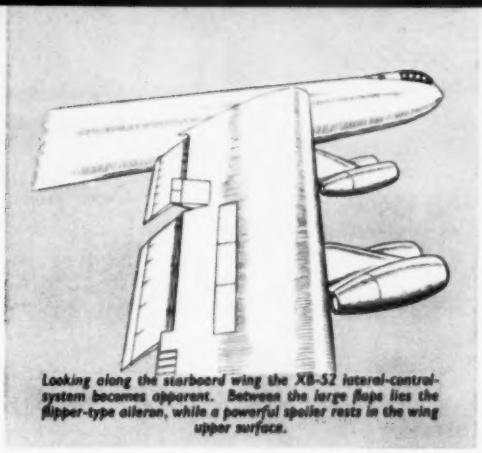
They received a most unexpected reception. Colonel H. E. Warden told them that, in spite of previous indications, the U.S.A.F. no longer believed a turboprop bomber could do the type of work likely to be demanded of it. But, rather than administering a setback, he was offering a welcome challenge. "What we're interested in, as of now," he said, "is a look at what can be done in the way of a long-range bomber powered by pure jet."

So it transpired that, over a single week-end in a Dayton hotel, the present B-52 design really began. Using the Pratt and Whitney J-57 turbojet, then under development, as a basis, all the results of the previous turbojet studies were collected and worked into a single design. Ed Wells, Boeing's vice-president (engineering), drew up a rough outline drawing of the aircraft; Art Carlsen, senior project engineer, and Maynard Pennell, chief of preliminary design, completed the weight breakdown; H. W. Withington (power plants) and Vaughan Blumenthal (aerodynamics) estimated performance; and George Schairer, Boeing's present chief of technical staff, developed a new swept wing. Finally, Schairer went out and bought some balsa wood, from which he hand-carved an accurate model of the project.

On the Monday morning, the team were back at the A.M.C. offices, armed with the model and a 33-page formal document on the new design. And this design is essentially that which has been built, and is to go into large-scale production for the Strategic Air Command. The "real thing" does, in fact, differ externally only in having slightly more severe lines, reflected in a slab-sided fuselage and the absence of a curved dorsal fin.

It is thus four years since the B-52 design was formulated. In this time much has been learnt that has been worked into the design, and much more has perforce been neglected. But the Stratofortress, as the new bomber has been named, represents the present limit of the "American" bomber layout—typified by a large fuselage, high aspect-ratio swept wings, and severely podded power plants. It is felt that an appraisal of this remarkable bomber will—although premature in that it must be based upon external features—bring to light a number of points which may have passed unnoticed.

The 153ft fuselage shows a distinct departure from previous Boeing practice in that its section is not circular but "slab-sided." Bearing in mind the range required, it is safe to assume that this increased volume is entirely occupied by fuel tanks; the main B-47 tankage appears to have been laterally disposed, but the B-52 tanks almost certainly take up the entire fuselage width. In this connection it may be remarked that the B-52 is to be developed as



Looking along the starboard wing the XB-52 lateral-control-system becomes apparent. Between the large flaps lies the flipper-type aileron, while a powerful spoiler rests in the wing upper surface.

an airborne tanker and it will also have underwing fuel tanks.

The forward 28ft consists of a highly-pressurized crew compartment, entered by a hinged ventral stairway. The large canopy is particularly interesting; it is scarcely broader than that used on the B-47, but a large number of small transparent panes have been selected, located in heavy framing. This no doubt reflects upon the pressure differential; in any case it is very different from British practice of using a broad, flat canopy with side-by-side crew seating—although Boeings are now considering side-by-side seating for the production B-52s.

The main load-carrying centre-fuselage is about 68ft long, and is of constant section. The four undercarriage units are hinged on two transverse axes about 50ft apart and between them is the bomb-bay, less than 30ft long. Main fuel tankage is probably contained in the upper fuselage although it is certain that the pressure-fuelling points are mounted lower down—perhaps within the undercarriage wells. The entire belly is made up of doors and access panels, and a number of large, gridded orifices visible around the forward undercarriage are probably cabin-air exits.

The rear fuselage is some 58ft in length and tapers uniformly to a pointed tail. In the extreme tip is an armament mounting with a gunner's station above. The armament is evidently to be radar-controlled by a central scanner and, from the prototype mock-ups, appears to consist of two cannon or missile launchers. The gunner's space must be pressurized and it is doubtful if it is connected with the nose *via* a tunnel, as in earlier bombers. A separate entry door beneath the tailplane lends some support to this theory, particularly since this door is over 12ft from the ground. At present there is no evidence of any other crew position or armament.

The wing of the B-52 is something to delight the aerodynamicist and, in some ways, the stressman also. It represents the solution to as difficult a set of design criteria as have ever been required, and, while a delta would undoubtedly have been much easier structurally, the American designers pinned their faith on "the devil they knew," to wit, a heavily loaded structure of extreme flexibility.

The span is 189ft, and the aspect ratio of about 9 (lower than the B-47 figure) gives an area of some 4,000 sq ft. It should be remembered, however, that the aspect ratio of a swept wing appears as a lower value than the structure suggests; the sweep on the B-52 is 35 deg, as on the B-47. Skinning is of very heavy gauge throughout; no stress wrinkles appear in flight and the skin not only carries much of the load but also contributes significantly to rigidity. But the flexibility is still very high, and is sufficient to cause the ground anhedral angle of several degrees to become, at the tips, noticeable dihedral in level flight.

The angle of incidence is extraordinarily large, being at least 7 deg; and the thickness/chord ratio is over 12 per cent at the root, although the remainder of the wing is much thinner. All primary bending loads—other than those taken by the skin—appear to be absorbed by the very massive single spar at 50 per cent chord, which stretches unbroken to the tip. There is certain to be a secondary spar further aft carrying the flaps, but the remaining structure seems to consist solely of numerous chordal members, placed normal to the leading edge. The main spar and thick skin thus form a strong torsion box capable of carrying the very considerable twisting loads.

The flaps are of a modified Fowler type, running in guide rails at right angles to the trailing edge; the inner flaps thus move in towards the fuselage as they are lowered. Four flap sections are fitted, each section being some 9ft 6in in chord; the total flap area is about 1,080 sq ft, and the maximum deflection 50 deg. Differential flap movement has been reported, but the reason for such a feature is obscure. The control surfaces are discussed under a separate heading.

The dominating feature of the tail is the vast vertical surface, but all tail surfaces are similar, with a single spar at the mid-chord point. Lighter spars can also be seen, together with very many chordal members. The vertical surface bears a marking reminiscent of a "flash of lightning" on its left-hand face. The explanation lies in the fact that the entire structure is hinged at the root and can fold to starboard to lie parallel to the tailplane; in this condition, the black border of the marking shows servicing personnel the perimeter of the area upon which they may walk. Similar markings are found over the upper surface of the wing and along the fuselage. In passing, it may be remarked that, since the flight loads on the fin are probably greater than the load due to its folded weight, folding and erection should be possible by the use of jacks at the fin root.

It has been difficult to avoid touching upon the subject of the B-52 control system before this point, but the methods adopted are clearly unique and merit treatment on their own account. The problems posed by this aircraft are very great.

First, the outer engines are mounted some 63ft from the aircraft centre line. Failure of the outer engines on one side of the aircraft could impart a yawing moment of 1,250,000 lb ft—an unprecedented figure. Secondly, the control system must be efficient at high Mach numbers and altitudes while retaining good control at low speeds and low altitudes. Thirdly, the wing structure has already been described as unusually flexible. Our American contemporary *Aviation Week* first discussed the B-52 lateral controls; it is our intention to carry their reasoning one stage further and consider the complete system.

The wings appear to be fitted with ailerons of unusually high aspect ratio; in reality they are not ailerons at all but—as will be explained—are fixed installations. The expected aileron position is 50ft behind the wing spar at the root, and the outer wing is flexible both in bending and torsion. Normal ailerons would, therefore, introduce mechanical troubles—due to wing thinness and deflection—and might have the opposite effect to that intended, due to wing twisting. The true ailerons appear to be small surfaces mounted between the flaps in way of the efflux of the inner engines. These surfaces are hinged to the wing very near their leading edges and are, in effect, plain flaps of about 56 sq ft each. Their trailing edges carry, in turn, what appear to be one servo tab and one trim tab. And each aileron can move up, or down, independently.

Further lateral control appears to result from large spoilers mounted on the wing upper surface at about 65 per cent chord. Each spoiler consists of a number of flat plates, hinged along their forward edges to form a wall some 19ft long and nearly 3ft high. The plates are actuated by jacks which provide for upward deflections of the order of 60 deg; intermediate positions are unlikely, since photographs show individual spoiler plates in use. The method of operation, therefore, is likely to be the use of the trailing edge ailerons for normal purposes, backed up by one or more

The YB-52 makes a striking picture as she cruises over the American Pacific coast. Various causes may be responsible for the fact that a single section of spoiler is open above the starboard wing.

Even during early test flights the YB-52 weighed over 100 tons, and the landing speed is probably about 150 knots. But there are eight powerful brakes, four large flaps, large spoilers (seen open) and a tail parachute, which combine forces on occasions like that pictured here.

Stratofortress . . .

sections of spoiler for emergencies. The spoilers act both by increasing drag and by destroying lift; they would be brought into action, no doubt, in the case of engine failure (yawing) as well as in rapid rolling manœuvres.

Both vertical and horizontal tail surfaces are plain, rigid metal structures as far back as about 90 per cent chord. Then follows a simple hinged and balanced surface upon which is mounted a large tab, or, in the case of the vertical surface, double tabs. Brief inspection shows that the entire horizontal surface is hinged at the two-thirds-chord point, the limits of movement being about +7 deg and −5 deg. It is probable that this extremely powerful arrangement is used chiefly for trimming and emergencies, in contrast to the "all-flying" tail used on supersonic fighters.

The nature of the vertical surface is less obvious. Bearing in mind the fact that it folds, the suggestion of its being, likewise, an "all-moving" surface implies severe problems. But it so closely resembles the tailplanes, and the "rudder" is of such insignificant chord, that such a conclusion seems probable. This is strengthened by the obvious "single-point" attachment of the fin at the main spar root at the 55 per-cent-chord point. But the thought of a fin of some 488 sq ft area, and 30ft high, being hinged along two axes, is not one to inspire confidence. If this really has been achieved it is an engineering masterpiece.

For landing, the spoilers are opened fully and the flaps lowered; tailplane incidence appears to be increased under these conditions. In normal flight, with the autopilot engaged, the hinged trailing edges of the tail probably act as primary flying controls, trimmed by their tabs. In emergencies, they probably behave as servo tabs to move the main surfaces. For example, tailplane incidence may be reduced to pull the bomber round in a tight turn, initial bank having been applied by one spoiler.

The B-52 is powered by four pods, each housing a pair of Pratt and Whitney J-57P-1 turbojets. These are massive, split-compressor engines akin to our Olympus. They are very heavy units, and are certainly powerful—up to 12,000 lb thrust each being suggested. But in the YB-52 prototype the first eight are delivering around 8,800 lb thrust. The YB-52 engines are at present started by a ground trolley powered by a Boeing Model 502 gas turbine; production B-52s will have a built-in starting system powered by a Continental-Turboméca unit.

The geometry of the pods is unusual; their extreme forward sweep is no doubt due to aerodynamic and c.g. considerations; but the engine weight also causes a nodding load supplementing the twist introduced by the wing sweep. Although the engines' low thrust line brings them down to the aircraft c.g. level, a complication would appear to be caused by this same fact, namely, that the effect of varying engine power in flight could introduce twisting moments on the wing, so altering the effective angle of attack. This is another point in favour of the buried engine layout.

The outer pods are particularly useful as fixed masses for damping wing flutter. In fact, with a weight of five tons mounted over 60ft from the wing root, and with a second pod at the 35ft point, wing vibration in the B-52 is unlikely to have given much trouble. The pod fairings should also assist in preserving chordwise airflow, after the manner of fences. But buried engines give less drag . . .

The Stratofortress undercarriage is a double-bicycle system, the actual units being very similar to those used on later B-47s. Each main leg is mounted on a bottom fuselage longeron and retraction follows the leg action of a giraffe—the port units going in and forwards, and the starboard retracting in and to the rear. The "wheelbase" of 50ft must cause severe sagging loads and may result in the bomb doors having to be stressed accordingly. The track measured between the legs is about 9ft; but added lateral safety is afforded by the small outrigger wheels 77ft from the aircraft centre-line, which retract inwards into the wing. These "protection units" as they are termed, cannot both touch ground at the same time and, on take-off, wing flex raises them high in the air.

The B-52 must weight at least 300,000 lb loaded—giving a wing loading around 75 lb/sq ft, or less than that of the B-47—and braking problems make provision of a tail parachute mandatory, although this asset has only been used occasionally during lightly-loaded early test flying. With the B-47, it has been found that reduction in tyre wear nearly pays for the cost of the 35ft parachute carried by that aircraft; average figures in U.S.A.F. service are: cost of parachute $1,200; cost of tyre, $300+; life of parachute, 35 landings or over; life of tyres, 25/30 landings without parachute, or about 50 with parachute employed. To these figures must be added brake wear and labour costs. The same order of results may be expected with the B-52. The larger bomber carries its parachute in a cell above the tailplane, and the canopy is streamed through a large door on the starboard side hinged at its forward end.

The prototype B-52s do not carry any provision for assisted take-off, although a RATO installation will be found on the production model similar to the liquid-fuel bottles used by the B-47. Runway requirements of both the Boeing jet bombers are severe; both demand at least 8,000ft of thick concrete, and their tyre pressure of some 150 lb/sq in is only equalled by that required by certain much-less-weighty fighters. Surprisingly, the Goodrich wheels do not use disc brakes, but employ a narrow-cavity expanding tube. A new, rivetless brake-block is fitted in which the lining is cemented to a magnesium shoe.

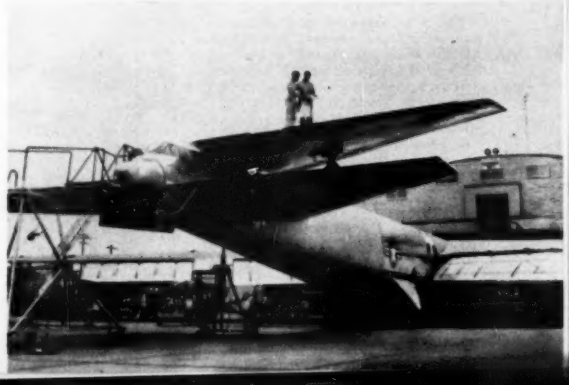
Very comprehensive radio and radar equipment can be assumed for the Stratofortress, external manifestations of which include the profusion of glass-fibre suppressed aerials or radomes. On the YB-52, most of the nose is radome—probably a bomb-sight beneath and a cloud/collision-warning scanner above—and suppressed aerials are found on the fin, both at the tip and on the sides, and also in the location normally occupied by the ailerons.

Of the B-52 armament system—already discussed—we may assume that it will lean heavily upon B-47 experience. On this earlier bomber $50 million were paid for development of a fire-control system now all-but abandoned, and contracts for a further $105 million have recently been cancelled. One cannot estimate what proportion of the B-52 cost will be due to electronics, but it should be a lower percentage than on the B-47.

The initial B-47 tooling at Seattle alone cost $52.5 million, with a similar bill at Wichita, Kansas. Both these plants are likely to be turned over to the B-52 eventually. Since we have been dealing with a big aircraft, it is appropriate to close with big figures: the fly-away cost of the first B-47 was $21.3 million, and the present price per aircraft is about $3.8 million—with over 300 already delivered. The total bill for the B-47 and B-52 is, according to Mr. Wellwood Beall, Boeing's senior vice-president, $10,000,000,000. Perhaps some of this might go to finance a jet transport for more pacific purposes.

W.T.G.

Folded flat, the mighty fin lies over the starboard tailplane. At the base of the fin can be seen the exit door for the tail parachute. Beneath the tailplane are two large open access-panels, behind one of which can be seen the rear gunner's entry door



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THE PIAGGIO P.150

Alvis Leonides Intended for New Italian Trainer: P. and W. Version Described

THE second aircraft to be designed to meet the Italian Air Force specification for a Harvard replacement, the Piaggio P.150 made its first flight in the middle of November from Villanova d'Albenga Airport on the Italian Riviera. The firm's chief test pilot, Commandante Aldo Gasperi, was so pleased with the machine that he gave an aerobatic display before landing.

In general appearance the P.150 follows the pleasing lines of the P.148 initial trainer, which is now in service with the Aeronautica Militare, although it is actually a completely fresh design. The P.150 is a straightforward tandem-seater monoplane of conventional all-metal construction. A particularly sturdy structure, with close-spaced skin stiffeners, has been chosen in order to withstand the rough usage of training schools. All control surfaces, and the slotted flaps, are metal covered, although internal structure has been virtually eliminated by using integral stiffeners in the form of closely-spaced channels pressed into the skin. All controls are mass-balanced and there are trimming tabs on the elevators and rudder, and adjustable tabs on the ailerons. A simple cantilever undercarriage, retracting inboard, and a fixed lever-action, castoring tail wheel are fitted.

The cockpit is set high in the deep fuselage, so giving an excellent forward view to both occupants, on the ground as well as in the air—a most important consideration in a trainer. The large, one-piece, clear-view canopy slides right back to the tail, and a small dorsal fin incorporates the central guide-rail for the canopy.

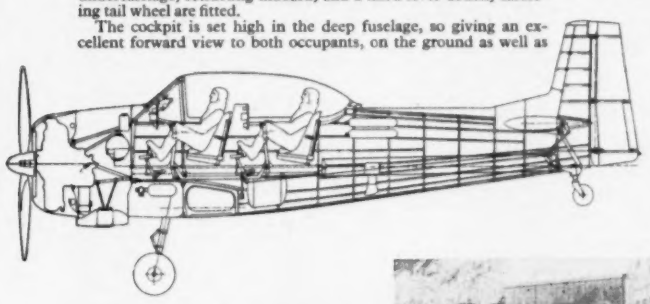
As in the P.148, precautions have been taken to ensure good spinning characteristics; a tall rudder well aft of the tailplane, a deep rear fuselage, washed-out wing incidence—these are features that should make recovery easy.

The engine used in this first prototype is a direct-drive Wasp R-1340-S3H1, but work is in hand to instal a geared Alvis Leonides in a second aircraft. As is customary with this model of the Wasp, the cowling has no adjustable cooling gills. The airscrew is a two-bladed constant-speed Hamilton Standard.

Like all post-war Piaggio aircraft the P.150 was designed under the supervision of Dott. Ing. Giovanni Casiraghi, engineering director of the Aviation Division of Piaggio. The company is very pleased with the first tests and the performance, which has exceeded estimates, and flight tests for a C. of A. are already well advanced.

DATA FOR PIAGGIO P.150
(Pratt and Whitney Wasp engine).

Empty weight	4,277 lb
Gross weight	5,600 lb
Wing loading	20.7 lb/sq ft
Power loading (take-off)	9.4 lb/h.p.
Max. speed at sea level	225 m.p.h.
Max. speed at 5,000ft	237 m.p.h.
Stalling speed at sea level (flaps down)	64 m.p.h.
Stalling speed at sea level (flaps retracted)	74.5 m.p.h.
Take-off run	705ft
Take-off distance to clear 50ft	1,280ft
Landing run (using flaps and brakes)	722ft
Rate of climb at sea level	1,660 ft/min
Climb to 5,000ft	3 min
,, ,, 10,000ft	6 min 45 sec
,, ,, 15,000ft	12 min
Service ceiling	25,200ft
Range at sea level (plus ½ hr flight reserve) at 195 m.p.h.	585 miles (111 gal) or 880 miles (159 gal)



Several of the P.150's good features are apparent in the drawing above, notably the "visibility," simple structure and clean outline.

The prototype P.150 is here seen carrying singularly neat miniature rockets beneath the wing. These weapons are comparable in size with the various American air-to-air missiles, but are probably used for air-to-ground training.

CRANFIELD'S WORK-STUDY SCHOOL

THE facilities at the College of Aeronautics for the education of aircraft production engineers have become recognized in this country as second to none. Since the introduction of aircraft economics and production as a specialist subject in 1948, the number of students taking this post-graduate course has steadily increased, and is higher this session than in any of the college's other departments, including those of Design, Aerodynamics and Propulsion. Work study has always formed an important part of the production course, and it has now been decided to make training in this subject available to a greatly increased number of people, by the formation of a separate Work Study School.

The need to increase output and productivity is not confined solely to the aircraft industry, and the new school has drawn staff, and will recruit students, from a wide range of industries. The purpose is to provide comprehensive ten-week courses, based on modern practice in work study, to meet the needs in general industry of work-study specialists, and of junior managers requiring a knowledge of the subject for effective executive control. The subjects include method study, work measurement, labour control, cost control, incentive schemes, industrial relations, statistical method and financial and economic aspects of work study.

The courses will consist of morning lectures and afternoon practical training sessions in specially equipped demonstration rooms and workshops—and occasionally, when appropriate for associated subjects, in the college laboratories. At suitable stages during the course, factory visits will be arranged.

The Work Study School, although in effect an entirely separate teaching establishment, is an activity of the Department of Aircraft Economics and Production at the College of Aeronautics, and is therefore under the general administration of Professor J. V. Connolly, B.E., F.R.Ae.S., M.I.Prod.E. The director of studies is Mr. H. C. Wiltshire, M.Sc., M.I.Mech.E., M.I.E.E., M.I.I.A., who is responsible for the teaching in the school. Staff lecturers appointed to date are Mr. B. W. Carver, A.I.I.A., F.R.Econ.S., Mr. L. J. Harper and Mr. F. I. Mudditt.

An advisory committee, including representatives from industry, the T.U.C., the British Institute of Management and the College of Aeronautics, is being set up to guide the development of the new courses, which will normally coincide with each of the three college terms. The first course will begin on January 12th, 1953.

HELICOPTER ASSOCIATION LECTURE

TONIGHT, December 5th, a joint lecture entitled *Simulation of Flight Loads by Ground Tests* is being delivered to the Helicopter Association of Great Britain by Messrs. R. Hafner (chief designer, helicopter department, Bristol Aeroplane Co., Ltd.) and M. J. Brennan, B.Sc., who was recently appointed chief designer of Saunders-Roe, Ltd. The lecture is to be given at the Royal Aeronautical Society, 4 Hamilton Place, London W.1, at 6 p.m. On November 27th Mr. Hafner lectured on *The Helicopter for Passenger Transportation* to the I.o.W. Branch of the R.Ae.S.

Are Flight Dispatchers Necessary?

New Arguments on a Particular Aspect of Airline Operation

By J. VIVIAN, D.S.O., D.F.C., F.Inst.Nav.

IN an article in "Flight" for July 25th, Mr. Rupert H. Giles, D.F.C., put forward the case for the employment of "flight dispatchers," ground-based officials who would relieve airline captains of a certain amount of operational responsibility and thus, he maintained, secure increases in regularity and economy. In the present article, Mr. J. Vivian challenges some of these opinions. In his view, the employment of flight dispatchers would be expensive in itself; he feels that there is more to be gained by —in particular—the introduction of improved communications networks. Mr. Vivian, who here expresses personal opinions, is British European Airways' training and services manager.

A RECENT *Flight* article, on the subject of the necessity or otherwise for airline "flight-dispatchers," raised several controversial issues. There was much substance in what the author said and particularly pertinent was his suggestion that ways and means must be found which would greatly reduce turn-round and transit times for the new aircraft types (and also for existing ones—all are too expensive). No one will quarrel with this particular viewpoint, but the controversy arises in the suggested need for so much ground operational control for *all* operations, and in the method in which the problems posed can best be resolved. Mr. Giles suggested the flight-dispatch system is the answer. I do not entirely agree with him—for short-haul operations, at any rate—neither do I consider that we require the form of control that he envisaged, and I wish to put forward an alternative requirement.

Before doing so, perhaps it is as well to re-define the fundamental tasks of the operations department of any airline. In my opinion, these are :—

(a) To provide the highest level of safety.
(b) To attain maximum regularity and punctuality, irrespective of conditions. (Regularity is defined as the percentage of scheduled stage-flights which are actually completed—excluding those cancelled because of "no load." Punctuality is defined as the percentage of scheduled stage-flights which are actually completed on time.)
(c) To reduce to a minimum the ground-time requirements to transit a station or to turn round a service.
(d) To secure maximum effective utilization of all flying staff and aircraft.
(e) To provide maximum payload, consistent with safety and efficiency, at all times.

Each of these items is of prime importance to an airline; (a) and (b) are fundamental, and, rightly, are the subject of continued thought and development by large groups of airline personnel. They are given such prominence that comment here is superfluous, except when considering in-flight control, of which more later.

There remains, then, the minimizing of ground-time requirements, the attainment of maximum utilization of flying staff and aircraft, and the provision of maximum payloads. Each is interrelated with the other in varying degrees, particularly the first and second, and must therefore be considered in detail.

The minimizing of transit and turn-round times for commercial services has always been a prime requirement and *must* be achieved within the next year if we are to obtain the benefits of the newer and larger aircraft. Before attempting to suggest ways in which this reduction can be achieved, it may be as well to consider the various procedures normally occasioned at foreign transiting-points. Principally, these are :—

(a) Clearance so that the flight can depart on schedule; or, where necessary, the establishment of the delay-time involved.
(b) Application of aircraft performance to determine what restrictions, if any, have to be imposed on take-off weight.
(c) Preparation of the flight plan and the determination of the fuel requirement for the next sector.
(d) The filling of an A.T.C. clearance.
(e) The physical loading of the aircraft, refuelling and documentation.
(f) The compliance with any other mandatory State requirements.

It is an undisputed fact that none of the normal station functions can be completely performed until the captain has carried out most of his work and has decided, amongst other things, his fuel requirement. Here, then, lies the root problem, and the question is posed as to whether these functions can best be speeded up by taking them out of the hands of a service captain, or whether some other means should be found of providing him with the necessary pre-flight briefing information, in such a manner that the equivalent economy in time can be achieved. Probably there is the third alternative of streamlining existing procedures and so reducing the time element. One can, however, go only so far in this direction, and the main problem will remain largely unresolved. Certainly dispatchers can help, because they will reduce the time requirement by carrying out most of the necessary functions to determine fuel load, and hence payload, before the aircraft arrives. The cost of providing such a service will be very considerable, however, particularly where numerous stations are involved, and it behoves us to examine all other means at our disposal before deciding on such a step.

As an alternative, we may, therefore, consider the development of air/ground communications for company purposes, such that the captain may be advised, before landing at any destination, of the essential characteristics of the weather for the next stage of his flight, including the landing, and so can make whatever calculations are necessary for that next stage before landing at the intermediate point. Likewise, he can be advised of any peculiar commercial requirements that the local staff may have for that service. Certainly, this scheme would appear to have immense possibilities, and perhaps the most significant is that of cost, which should be less than that involved in the development of the flight-dispatcher system.

The preparation of a flight plan, as such, presents no problems to airline pilots; the problems arise in determining the weather characteristics which are to be assumed in preparing the plan. Were it possible to forecast conditions of wind, weather and temperature sufficiently far in advance, with a high degree of confidence on all occasions, much of the substance of our present limitations would be eliminated. Unfortunately, the vagaries of our weather in these so-called temperate latitudes, combined with the immaturity of our present methods of forecasting, are such that accuracy of the desired order is not achieved. But the point is that, no matter how inaccurate or uncertain met. forecasting may be, dispatchers or other company officials cannot change the circumstances; indeed, they cannot and must not influence the duty meteorological officer in his forecasting. At best, they can but pose the necessary vital questions and so help to elicit the most complete picture of weather conditions expected to obtain in the future. This, however, has not in any way affected the accuracy of the forecaster's work; he is still just as likely to be right or wrong, whether or not a flight dispatcher is on duty. Therefore, in considering flight-planning aspects, can it be argued that a flight dispatcher is capable of producing a more accurate plan than a service captain? Surely not.

The Man on the Spot

Time-saving is therefore the only advantage and, to repeat myself, I submit that we can achieve this equally well by properly regulated air/ground communication channels. If it were possible for a captain in flight to obtain such information (regarding weather conditions on his next sector) as would normally be given to a flight dispatcher, and perhaps be given the facility to pose and receive answers to pertinent questions, may it not follow—in this respect at least—that the captain can carry out this particular part of a flight dispatcher's duties equally efficiently, and without the cost? Provided that such information is made available, and that the captain has been advised of his company's special requirements for any particular service (and, where weather conditions are marginal, of any over-riding current commercial requirement) there is surely no reason why he should not make the same decision as the flight dispatcher.

One could go further and say that in certain circumstances the captain is able to make the better decision, particularly when he is returning over a sector on which he has recently flown. In such cases—and they occur frequently on short-haul operations —the captain may well be more fully acquainted with actual conditions and their possible development than are the meteorological officers, relying as they have to on three-hourly charts and "de-briefing" information.

Overall, the greatest contributions can, of course, come from the meteorological staff themselves, by the provision of accurate forecasts, particularly for terminal areas; but that is another story.

Our next requirement, that of effective crew-utilization, is dependent on correct scheduling and the elimination of unnecessary ground-time. Proper scheduling of flying staff is a subject outside this article, but reduction of ground times is not. However,

if we are to achieve this aim, we must go back to the root cause of lengthy transit or turn-round times. Solve this problem, and we shall at the same time have made a material contribution to improving crew utilization.

The provision of maximum payloads was the next essential. It may be remembered that Mr. Giles put forward a plea for the abandonment of the fixed-sector fuel basis in favour of one which matched the fuel requirement to weather conditions for any particular day. This is precisely the system that has now been adopted by one of the British airlines and, though it was introduced only last summer, the indications are that it represents a considerable step forward, both as an operating standard and as a commercial requisite.

To describe fully the details of this variable-fuel method of operation would take too long here, but it necessitates a precise determination of the wind component expected along the route, and a careful consideration of the weather conditions forecast for the destination area and its surrounding alternates. This requires a forecast of landing conditions at each alternate and a personal assessment of the entire flight. For the correct decision o be made on all occasions it is necessary for full meteorological details to be made available, but this does not raise a new problem. The information is already available; it is only a case of presenting it to a service captain in such a way and at such a time that he can make the necessary deliberations and calculations without affecting the turn-round or transit time. Flight dispatchers? Certainly, but why not equally well by the captain through the medium of air/ground communication facilities? We are concerned with the aspect of introducing the variable-fuel technique, so securing maximum payload and standardizing the safety element, whilst at the same time effecting an overall reduction in transit times. The captain can make the necessary calculations just as quickly as a dispatcher, providing he is given the information in sufficient time. Operations communications *could* provide the answer, thus permitting this technique, with its obvious safety and commercial advantages, to be introduced for each sect-r without adversely affecting the time required for transits or turn-rounds.

In-flight Control

So much for flight-planning and ground time requirements. What of in-flight control? Is there a need for it, who should be responsible, and how should the responsibility be exercised? Here we return to the fundamentals of safety, regularity and punctuality or, rather, elements of all three, for it should be remembered that a standard of safety, regularity and punctuality has already been built into any operation by virtue of the overall standard practices and procedures adopted by the airline.

What is the purpose of in-flight control? Surely to ensure the satisfactory termination of a flight, by which we mean the landing at the scheduled destination, or a previously selected alternate, without undue incident and with the maximum overall attainment of regularity and punctuality. This demands adequate fuel-reserves to cater for the conditions of flight on any particular occasion, and the obtaining and accurate reporting of meteorological conditions which are not below the approved minima for that airfield; or, where diversion action must be taken, making the correct decision and, furthermore, making it at the correct time (which, again, will depend on adequacy of fuel reserves and accuracy of forecasting of landing conditions.)

On short- or medium-haul operations, the service captain will have received recent briefing on conditions which are likely to obtain in the terminal area, and, if he is using the variable-fuel technique, will have uplifted the necessary amount of reserve fuel to cope with the anticipated weather. Conditions may—in fact, most probably will—change whilst he is in flight, for better or worse, and the fuel consumption may vary from that planned, due to more or less adverse winds than forecast, to re-routeings necessitated by weather, or to A.T.C. hold-ups. If the aircraft is fitted with accurate gauges or flowmeters the precise consumption is known and, by use of a suitably constructed cruise-control chart, the captain can at any time determine precisely the amount of fuel remaining and estimate the position at which a decision must be made regarding diversion action, with allowance for adequate holding.

Thus we return to the accuracy of weather forecasts. For the captain to make the correct decision, he must be provided with an accurate picture of latest weather conditions. If the company's landing-minima have been clearly defined and are capable of easy interpretation, and the weather reports are accurate, why should the captain make a wrong decision? Barring abnormal and overriding technical considerations which necessitate a speedy landing, a captain will not "risk" a landing in conditions below his company's stated minima. Why, then, should we consider that a dispatcher can make a *safer* decision regarding the practicability of a landing? Both will have to base their decision on the same weather report, and how can an official on the ground make a finer and more precise estimate of actual conditions than a pilot who is actually "up top"?

For safety reasons, therefore, one cannot accept the principle that flight dispatchers are in a better position than a captain to decide on the necessity for diversionary action—providing both are in receipt of the same weather reports. The required improvement in this direction will be achieved only when the measurement of met. phenomena has been improved to such an extent that the achieved accuracy is of the required high order. To achieve this, the meteorological organization may have to expend further money in the provision of new instruments, and further time in exhaustive research. This is where improvement is required to be effected—not eventually, but now.

I do not suggest that there may not be a need for advice from the ground as to the best action to take if diversion is necessary, or if conditions are such that lengthy holding will be required before a landing can be made. Commercial requirements vary from day to day, and sometimes from hour to hour, and captains must be advised of over-riding company requirements in such cases. Also, in the case of aircraft operating with particularly small reserves, there may well be the need for advice from the ground as to the possible holding-time at the major destination-airports. At busy centres such as London or Paris, some form of positive control may be essential, because of the effect on ground-handling arrangements, and the necessity to avoid "splitting" the available ground labour-force (traffic and engineering staff) over several airports. Such control is already a requirement at busy centres, but, it should be emphasized, is imposed for overall efficiency of company operations, not for safety.

It is vitally important that we do not lose sight of the ideal at which we are aiming. Meteorological forecasters are playing an increasingly important rôle in civil aviation, and there is a real requirement for the provision of forecasts of meteorological conditions at terminal aerodromes in such a form that they can be readily appreciated (and trusted) by a captain, and, when applied to the company's landing minima, ensure a correct decision. We should not attempt to patch up the present deficiencies by the provision of flight dispatchers or other company personnel. As an interim measure it may be essential at certain airports, but as a long-term commitment it must surely be fundamentally wrong.

No one will dispute the important part played by the meteorological services in the operational control of airlines. It is estimated that, as an average figure, some two per cent of aircraft operating in Western Europe have to carry out diversionary action during the winter months. Similarly, a winter average of two to three per cent of services are cancelled because of poor weather conditions. Naturally, many of these conditions are forecast accurately, and the irregularity must then be attributed solely to limitations of aircraft equipment and blind-landing systems. Many irregularities, however, result from a too-pessimistic forecast not subsequently borne out, and the effect on an airline's economies is most serious. These deficiencies will not be overcome by flight dispatchers. The problem must be resolved by the meteorological experts.

Pro and Con

We have reviewed the main requirements of an effective operations control organization. To what extent will the inception of a flight-dispatcher system meet these requirements? The system could well offer the following advantages :—

(a) A material contribution to the reduction in crew-time requirements at transits and turn-rounds.
(b) The earliest possible calculation of fuel requirements and, therefore, an early indication of the payload which is likely to be available.
(c) The early dissemination of any vital information concerned with the control of an operation.
(d) The psychological advantage to the captain, in knowing that one company official on the ground is entirely engaged in watching his welfare.

As against these advantages, we have the most serious disadvantage of cost, particularly for any short-haul, high-frequency operator—assuming, of course, that a dispatcher was located at each terminal; the number required on such a network would be very considerable. Indeed, for such operations, it may be argued that the dispatcher's contribution would be strictly limited, because in-flight control is not a requirement for these operations. Weather deteriorations, though serious in their effect on the overall pattern, cannot play such a prominent part in ground control because there is a relatively small time-lapse between briefing and actual arrival at the destination.

Whilst, therefore, flight dispatchers considered on a world-wide basis can perform a worth-while function, their value appears to diminish with the shortening of sector-lengths. For short-haul operators the real answer probably lies in the employment of such officials at larger bases only, where the frequency of operations is such that the contribution such personnel can make in the saving of crew time, and in minimizing the dislocation to services, is such as to make it economically worth-while.

Although flight dispatch is clearly of less value for short-haul operations, the provision of adequate operational control

Are Flight Dispatchers Necessary? . . .

communication channels is of vital concern. As I have endeavoured to explain, the requirements which have to be met are, in themselves, simple. The problem is time—the provision of necessary information, either to a service captain or to ground personnel, at moments when it is required for the proper carrying out of any operation. Based on the present well-established principle of technical control of the aircraft remaining with service captains, this means that aircraft in flight must be advised (and be capable of advising ground personnel of the company) of any pertinent information concerning the continuation or termination of a flight. This can come only through a well-developed communications system.

What is really required is the provision of adequate operational control-communication facilities in each area, providing rapid communication facilities between the operations representative at the appropriate terminal and the aircraft captain in flight approaching that transit or turn-round station. This will permit the former to provide the captain with details concerning forecast weather conditions for his next destination, and also the *en route* forecast. The captain would, of course, have to be able to reply to such statements or ask any pertinent questions and get a rapid reply from the ground. Measured in time, however, the period involved for actual transmission of information between the parties concerned would not normally exceed a total of five minutes in the case of information concerning the next stage of flight.

The information to be exchanged would consist primarily of weather data from which the captain would decide whether to continue the flight or divert, and also would be able to determine his flight plan and fuel requirements for the next stage; this information—which, incidentally, would permit a loadsheet to be prepared in advance of the arrival of the aircraft—would then be transmitted to the destination staff for their further action. On receipt of such advice, the ground personnel would be in a position to make whatever further plans were necessary for the continuation of the flight, or alternatively, in the event of diversionary action being necessary, to advise the aircraft captain of company requirements.

Such facilities do not generally exist in the Region, but a number of European operators are actively pursuing the possibility of these being made available to them. In certain areas it may be either necessary, or desirable, for companies, individually or jointly to provide and maintain their own equipment, but in other areas it should be possible to arrange, on a limited basis, for these communications to be effected *via* the existing *en route* communication facilities—provided, of course, that the link between the company official and the ground radio station is adequate. The cost element might not be serious, if the facilities were on a cost-sharing basis, even allowing for the fact that companies may have to instal and maintain a number of stations themselves.

Such a scheme appears to have the very real advantage that the captain will be consulted direct and will thus be making his own decisions; therefore, no problems arise in relation to the responsibilities of the captain *vis-à-vis* himself and other company officials, and, at the same time, the goal which is sought should be reached. The preparation of the flight plan, the determination of the fuel requirement and the filing of flight clearance with State authorities, as well as the preparation of the loadsheet for the next sector, can all be completed before the aircraft lands. In-flight control, surely a cardinal responsibility of a captain, can be most effectively produced in conjunction with ground personnel where desirable. There may also be a further complementary advantage, in that ultimately and, due to the "spreading" of time available to complete various functions, it may be possible to reduce station staffs.

Little has so far been said about the reaction of flying staff to these several proposals. There can be no doubt that pilots will consider any development of the dispatcher system as a reflection on their professional status. Whilst, as Mr. Giles says, we should not permit such thoughts to hinder progress, there is no point in creating such a problem if it can be avoided. I submit that to leave present responsibilities firmly in the hands of the operating captain, whilst at the same time providing him with facilities so that decisions can be made at a sufficiently early time, will prove a better solution to the problem.

Flying staff are an expensive commodity. Much money is expended in initial training and in maintaining them at a high standard of efficiency. From a purely common-sense viewpoint, therefore, can we afford to supplement them by the provision of further control staff? At a time when most airlines are having to weather an economic storm, surely it is better that we so design procedures and produce facilities such that flying staff are able to meet the new requirements and thus provide to an airline the full benefits of the specialized knowledge with which they have been provided. I repeat, I do not suggest that benefits cannot be obtained at certain major bases by the employment of officers who specialize in operational functions; indeed there is no doubt that considerable benefit can be obtained if this is adopted in a discriminating way. I do submit, however, that such a policy should not be necessary as a matter of routine for all operations.

In this article I have endeavoured to present the case precisely as I see it. I am convinced that if we can show that a flight-dispatcher system is necessary for an airline, then the responsible opinion in the pilots' associations will not be in opposition.

I am equally sure that if we can prove the requirement can be met by some other means, such as the development of a network of communicating stations for company purposes, then both pilots and foreign administrations will accept the situation and do their best to meet our demands.

The problem is still wide open for discussion; it should be tackled energetically on a rational basis. My opinion is that an adequate operational communications system over the entire network, strengthened by operations staff at the major operating centres (such as London, Rome, and possibly Paris) is the real answer to the problem for short-haul, high-frequency operators in Europe.

BATTLES BY TELEVISION FILM

EPISODE 3 of the impressive documentary film "Victory at Sea," now being serialized on the B.B.C. Television Service (see *Flight*, November 14th), covered further stages in the Battle of the Atlantic. On this occasion, flying sequences were confined to brief glimpses of patrolling U.S. Blimps, R.C.A.F. Hudsons operating from Newfoundland, and a German Dornier Do 18 K flying boat. Light relief was provided by a remarkable shot of a smoke bomb being thrown overboard from a Catalina by hand, in best 1914-war tradition, to mark a suspicious oil trace.

The period covered by Episode 4, entitled "Midway is East," was of more interest and importance as it took in the turning of the tide in the Pacific and set the seal on the importance of air power over the sea. First shown was the battle of the Coral Sea, historic because it was the first naval action in which opposing ships did not see each other. In this battle one Japanese carrier was sunk and two damaged, while the Americans lost the *Lexington*.

Of greater importance was the much bigger battle for Midway, one of the most decisive in naval history. It was reasonable to expect an attack on these small, but strategically priceless islands, and the Americans were ready for it when it came.

The Japanese task force, consisting of battleships, cruisers and the same four carriers that had launched the attack on Pearl Harbour, was superior to that of the Americans, whose forces included three carriers.

The Americans opened the attack with a strong force of B-17s, but the Japanese not only knew how to operate carriers offensively, they also knew how to defend them and, by skilful evasive action, their fleet survived without a single hit being scored. The second attack was pressed home with gallant determination by 41 Grumman Avengers with torpedoes. Only six survived the accurate Jap anti-aircraft fire and again not a single hit was scored.

Then, as is often true of many a momentous battle, the fortunes turned with dramatic suddenness. American dive bombers pressed home a third attack, and within a few vital moments two Japanese carriers had been hit. A U.S. submarine arrived on the scene and added to the destruction. Soon the two surviving carriers were aflame and sinking.

In this battle the Americans lost the *Yorktown*. Japanese losses were the four carriers, one cruiser and—what was of probably the greatest importance—irreplaceable pilots and aircrew.

NOTES ON ICING

IT is generally accepted that the highest rates of ice accretion occur in strongly convective cloud, and as the free-water content of a convective cloud will normally increase with cloud-base temperature, serious ice accretion is to be expected in convective cloud in tropical latitudes.

In a recent Meteorological Office publication*, measurements of liquid-water content in strongly convective cloud at great heights in America are compared with theoretical values, and good agreement is found. The same method of computing the amount of water in clouds with much higher temperatures at the base is thus justified. After taking account of the variation with drop-diameter of the spontaneous freezing temperature of small drops, the probability of an aircraft encountering various concentrations of supercooled liquid water in strongly convective cloud in low latitudes is assessed.

* "*Occurrence of High Rates of Ice Accretion on Aircraft*," *by A. C. Best, M.Sc. Air Ministry, Meteorological Office, Professional Notes No. 106. Published by Her Majesty's Stationery Office. Price 9d.*

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The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Met. Halifaxes

I WAS most interested in Mr. B. J. Mitchell's account in your October 10th issue of a typical Atlantic meteorological sortie as undertaken daily by R.A.F. Coastal Command Hastings aircraft operating from Aldergrove, N.I. As the writer pointed out, these flights were instituted during the war and, in fact, many fell to the lot of that famous H.P. predecessor, the Halifax. These aircraft were mainly of the Mark 5 variety, being conversions of Mark 2

The Met. 5 1a Halifax referred to by Mr. P. J. R. Moyes.

series 1 and 1a Halifaxes withdrawn from Bomber Command. They were first given a thorough overhaul by Handley Page, Ltd., and had their Messier undercarriages replaced by lever-suspension units of Dowty design. Much meteorological recording and measuring apparatus was installed, although the sole external evidence was the psychrometer mounted on the side of the nose.

I enclose a photograph of one of these comparatively "rare birds," for, apart from one or two distant glimpses in official wartime photographs of those similar grey and white camouflaged Halifaxes which wrought such havoc amongst enemy U-boats and shipping in the Kattegat and Skagerrak, I cannot recollect having seen an illustration published. It will be noticed that this machine bears the same squadron code-letters as that of the currently operated Hastings depicted in Mr. Mitchell's article. This particular squadron was formed at Stornaway in August, 1943, and moved to Tiree during the following month. Engaged on long-range met. sorties over the North Atlantic, its grey and white painted Halifaxes were replaced by Mark 3 and 4 aircraft with the more familiar black sides and undersurfaces, in the spring of 1945, before it moved to Aldergrove.

London, N.W.3. PHILIP J. R. MOYES.

Flight-testing in Fiction and Fact

I HAVE just seen the film *The Sound Barrier*, and wonder why, when the producers have gone to such pains to explain the reactions of test-pilots and their wives, they have failed so miserably to complete the picture.

In *The Sound Barrier* the whole business of test-flying becomes mechanical and goes click click click just like a clockwork mechanism, which is the opposite to reality. For instance, there is never the slightest suggestion that the weather is unfit at any time or that the prototype becomes unserviceable. Anyone who has ever carried out any sort of prototype development knows that delays are frequent and that the lounging about, waiting for the machine and the weather to be right simultaneously, is probably more of a strain on the pilot than any other part of the job.

I remember one of the diving tests on the F9/40, which had to be made at a Mach number of just over 0.8 from 30,000 to 5,000ft. Once the machine was ready there was a wait of very nearly three weeks for weather before the attempt could be made. This revealed some of those "bronco effects" which are now well known to be associated with high speeds, but the really annoying thing was that the film of the automatic observer ran out half way through the dive, so that the last half of the dive (which produced a degree of shaking around 15,000ft) had to be done all over again. Although many things in test-flying may have changed since those days, I do not believe the delays have.

As for a pilot triumphantly announcing his Mach number to two or three places of decimals and having the result accepted forthwith, this is pure cinema. The film of the automatic observer has to be developed, projected on a screen, and read. These readings—perhaps hundreds of them—have to be corrected for instrument and other known errors before it is possible to determine, with acceptable accuracy, what speed has been reached.

I cannot conclude without protesting, in the strongest possible terms, about the ungracious slur on the Accidents Branch by omission of all reference to them or their work. If the producers of *The Sound Barrier* had troubled to ask they would have been told that the skilled and specialized knowledge of the Accidents Branch has been one of the principal factors in the improvement and development of aircraft. I have never heard of a designer who did not acknowledge the benefit of accident-diagnosis by these impartial experts. The application of data from Accident Branch reports has enabled dangerous features to be engineered out of new projects.

In spite of these criticisms, the film contains much that is excellent, such as the superb air photographs and the true-to-life pilots' offices with junk on the desks and little men popping their heads through hatches. This makes me lament all the more the failure to understand the built-in delays of the test-pilot's job, or to acknowledge the important contribution of the Accidents Branch.

London, W.1. JOHN GRIERSON.

[We are not anxious to reopen the *Sound Barrier* controversy, which had a very good airing some months ago, but for Mr. Grierson's interesting letter we have made an exception. He was responsible for much of the early jet flight-testing, and the F9/40 which he mentions was the Meteor prototype. He took it to America to demonstrate to the authorities there.—ED.]

Alliteration's Artful Aid

IT seems a pity that the Air Ministry are departing from the old system of naming aircraft where possible, with an initial letter which connects them with the maker. Surely the Vickers Valiant would have been more suitably named Vulcan, especially as that firm had already used the name Vulcan—for an airliner built in 1922 for the Instone Air Line. A very suitable name for the Avro delta bomber, incidentally, would have been Avalanche, in view of what it can let slide.

The Spitfire was an inspiration in name as well as in design, but I do not believe that there is such an animal. Expressive names have a great value and the Swift might have been better named the Stinger for alliteration, or Quickfire to show its descent from the Spit.

When next a Handley Page bomber emerges, a suitable name could be Hades, as that is what it is surely intended to create.

London, S.W.3. GEOFFREY DORMAN.

Vickers Vulcan (375 h.p. Rolls-Royce Eagle), flown by Capt. S. Cockerell in the first King's Cup Race, in 1922 (see letter from Mr. Dorman).

IN BRIEF

Mr. David Clarence Lee, of Weston-super-Mare, has sent a circular letter to the Press in order to find out whether his claim to having travelled "by every recognized method of flight by which man has been airborne" does, in fact, constitute a "world record." His list of aircraft—extending from 1916 to 1952 (he is now 54 years of age) consists of: balloon, observation type, 1916; airships, various, 1916-1919; aeroplanes, piston-engined—singles, twins and fours, 1917-1952; balloon, parachute-training type, 1946; helicopter, 1947; flying-boat (Sunderland), 1949; glider (T.21), 1950; jet aeroplane (Meteor), 1952. He adds that all his flights (which include day and night trips) were made while serving in the R.N.A.S., R.A.F. and R.A.F.V.R.; he has never flown in a civil aircraft. Mr. Lee's record appears to lack only man-lifting kites, free balloons, and—if they can be considered "a recognized method of flight"—parachutes.

AT THE ROYAL INSTITUTION

Members Hear a Lecture on the Comet

AN unusually informative paper was read before the Royal Institution of Great Britain in London on November 21st. The subject was the Comet, and the author was Mr. C. T. Wilkins, F.R.Ae.S., assistant chief designer of the de Havilland Aircraft Co., Ltd. Mr. Wilkins developed his story fact by fact and event by event with commendable clarity, and we have no doubt that his audience, representing wide interests and knowledge and accustomed as they would be to hearing only the finest of lectures on the sciences, found it most engaging and instructive. In view of their particular interest in aviation, *Flight*'s readers would have much of the information already in their possession—our special number concerned with the Comet (April 25th, 1952) was published mainly with this purpose in mind. Below, therefore, are printed a summary and some significant extracts and observations from Mr. Wilkins' paper; most of them, it will be found, provide new data or enlarge upon that already printed.

After tracing briefly the development of civil aviation from the days of simple aircraft employing well-tried methods of construction—he mentioned the D.H. 34, the Argosy, Hannibal and others—the lecturer led up to the jet era and discussed the advantages of this form of propulsion. Acknowledgement was made to B.O.A.C.'s part in early plans for the Comet. Mr. Wilkins then referred to design studies for a jet transport based upon a configuration similar to that of the D.H. 108 experimental and research aircraft. He said that this arrangement (40-degree swept wings, no horizontal tail surfaces, and elevon controls) as applied to the Comet showed, amongst other things, that owing to the low lift-coefficient of the swept wing, particularly during the landing, aggravated by the elevons and the increase in weight due to the swept wing, the penalty in payload would be in the order of 4,000 lb i.e., 2,000 lb for the loss of lift and 2,000 lb for the increased structure weight. The handling characteristics also left much to be desired, particularly during the approach and landing. This wing arrangement did, however, show great promise in other directions, particularly with regard to drag reduction at high Mach numbers, giving an increase in speed of about 50 m.p.h., but this was not considered large enough to offset the other disadvantages.

At the lecture: Left to right, Mr. W. E. Schall, chairman, Board of Visitors, Royal Institution of Great Britain; Lord Brabazon of Tara, Royal Institution president; Mrs. Wilkins; Mr. C. T. Wilkins, de Havilland assistant chief designer (who delivered the lecture); and Prof. A. O. Rankine, Royal Institution secretary.

The choice of engine was the next subject referred to, and this was followed by a discussion of the conditions involved in high-altitude flying.

Drag was then discussed, and it was pointed out that, due to its high fuel consumption and speed, the jet aircraft is particularly sensitive to drag. The most fruitful field for the reduction of drag lay in the form of the wing. The Comet has a thickness/chord ratio of 11 per cent, a sweep-back angle of 25 deg at 25 per cent chord, and a wing area of 2,015 sq ft. Owing to the large amount of fuel used in flight the wing loading for landing was much reduced.

Regarding tare weight, Mr. Wilkins said the jet airliner was sensitive to this factor also, because of the large fuel weight to be carried. The Comet's payload was only 10 per cent of the a.u.w. and the fuel weight was 49 per cent. Thus fuel consumption was of paramount importance, and a slight increase in tare weight would readily produce an aeroplane with negligible payload. According to B.O.A.C. figures, 1 lb of payload lost or gained on the Comet was worth £55 per annum per aircraft as passenger load or £38 as freight. For every 1 lb carried, ½ lb of extra fuel must also be carried, e.g., to carry a piece of equipment weighing 50 lb, the net loss in equivalent payload would be 75 lb. The converse, of course, applied if equipment was left off. In one way the jet aircraft was particularly good in this respect. Apart from the deletion of airscrews, the height of the undercarriage, and therefore its weight, could be kept small—and, incidentally, the aircraft was kept low on the ground, making for ease of maintenance and servicing.

The lecturer then referred to the difficulties of accommodating 7,000 Imp. gallons of kerosine in a thin wing of 115ft span. The fuel should be carried as far out along the span as possible to reduce the bending moment of the wing; owing to the wing sweep this brought problems of c.g. shift, and the order of fuel usage then became important.

Mr. Wilkins also had some remarks to make on fire risks, controls and noise. Tests, he said, had shown that although the jet efflux of the Ghost emerged with an included angle of about 14 deg, the highest noise-intensity lay in an included angle of about 90 deg; within this angle very severe local vibrations could be set up in any structure which was situated too close to the jet orifice and was insufficiently stiff.

The lecture was concluded with a description of ordering procedure and the organization behind the conception and production of the Comet—design team, experimental, production and servicing departments.

FORTHCOMING EVENTS

Dec. 5. Helicopter Association: "Simulation of Flight Loads by Ground Tests," by M. J. Brennan, B.Sc., and R. Hafner.
Dec. 5. Herts and Essex Aero Club: Annual Dinner and Dance.
Dec. 6. Northern Heights Model Flying Club: Annual Dinner and Dance.
Dec. 13. British Interplanetary Society: "Guidance and Control of Missiles," by J. Humphries, B.Sc.(Eng.), A.M.I.Mech.E., A.F.R.Ae.S.
Dec. 13. British Interplanetary Society, Birmingham Branch: "Fundamentals of Nuclear Energy Generation," by Dr. D. C. Leslie, M.A.
Dec. 16. R.Ae.S. Graduates' and Students' Section: "An Introduction to Aircraft Vibration," by D. J. Mead, D.C.Ae., Grad. R.Ae.S.
Dec. 16. R.Ae.C.: Film Show, Londonderry House.
Dec. 17. Institute of the Aeronautical Sciences, New York; Sixteenth Wright Brothers Lecture.
Dec. 17. Aircraft Recognition Society: Brains Trust.
Dec. 18. R.Ae.S.: Full-day Discussion on "Fatigue."
Dec.19-20. Institution of Production Engineers: Conference on Problems of Aircraft Production.
Dec. 20. British Interplanetary Society, Manchester Branch: "Rocket-motor Testing," by D. Hurden, B.A.
Dec. 30. Plymouth Aircraft Recognition Society: Meeting.
Jan. 3. British Interplanetary Society: "Planetary Engineering," by E. Hope-Jones, M.A.(Cantab.), F.R.A.S., A.M.I.Mun.E.; "Landing on Airless Planets," by R. A. Smith.
Jan. 17. Aircraft Recognition Society: Sixth All-England Recognition Contest.
Jan. 17. British Interplanetary Society: "Cosmic Radiation, its Intensity and Biological Effects." Lecturer to be Announced.
Jan. 29. R.A.S.: "Titanium", by Major P. Litherland Teed, F.R.Ae.S., M.Inst.Met., M.I.M.M.
Feb. 7. Helicopter Association: Discussion on Standards of Maintenance, and Requirements for Helicopter Engineers' Licences. Papers by Members of the A.R.B. and S.L.A.E.
Feb. 9. Institute of Transport: Brancker Memorial Lecture: "The Influence of Military Aviation on Civil Air Transport," by Sir Frederick Handley Page, C.B.E.
Mar. 14. The Cranfield Society: A.G.M. and Dinner.

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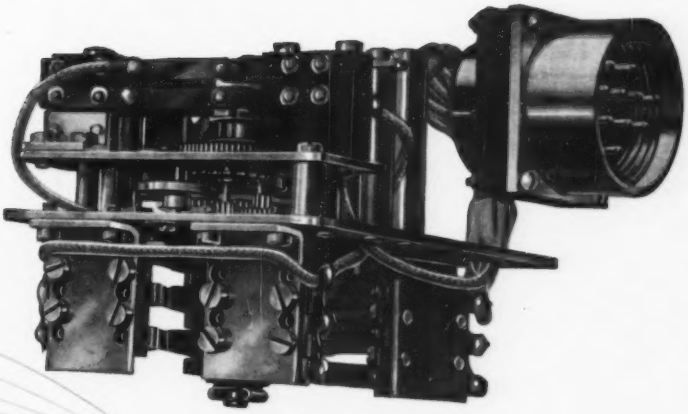

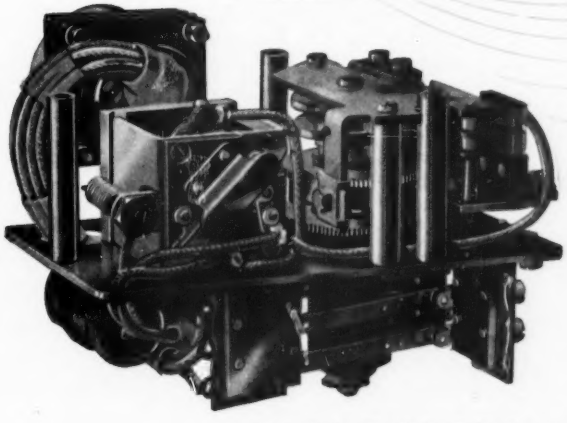

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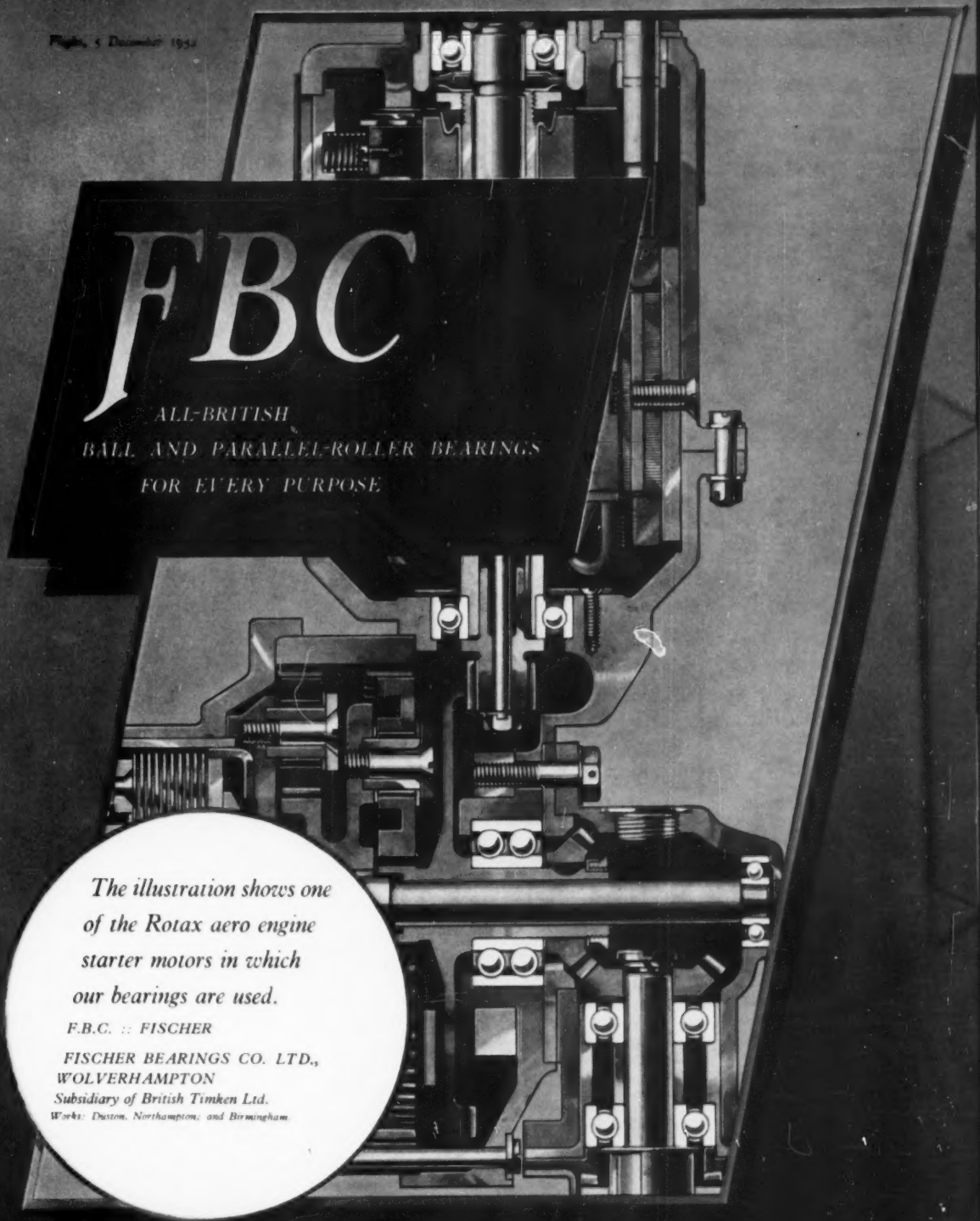

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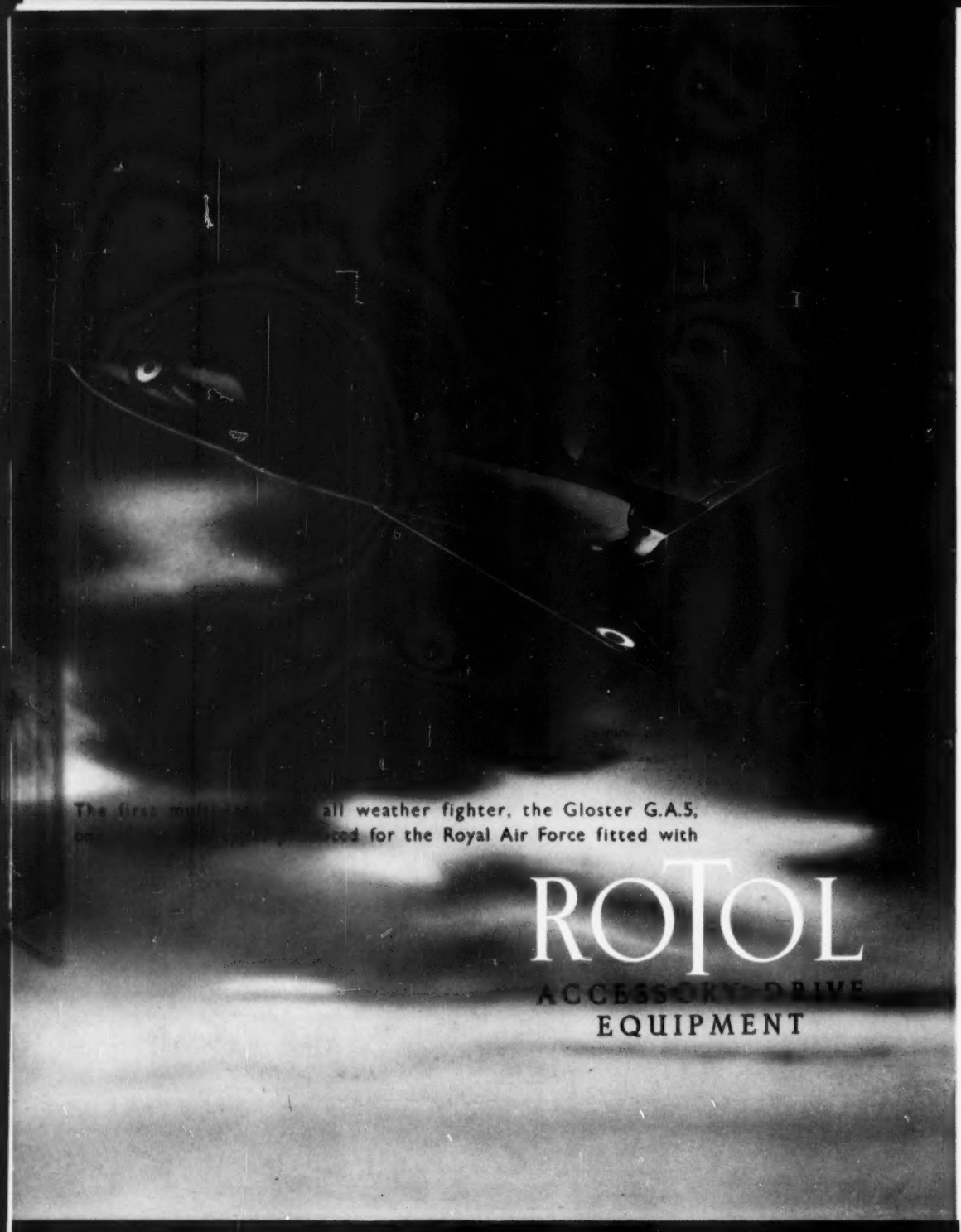

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CIVIL AVIATION

AID FROM I.C.A.O.

THE International Civil Aviation Organization has announced the appointment of Mr. E. R. Marlin, an American, as director of technical assistance. In his former capacity as external relations officer, Mr. Marlin has been responsible for developing the technical-aid programme since its initiation two years ago. Since then 27 countries have received I.C.A.O. help in setting up the ground services required for civil aviation. There are now 71 I.C.A.O. experts "in the field"—delivering on-the-spot advice and building up activities in various countries—and it is expected that 111 will be employed by next year. Member-nations of I.C.A.O. have co-operated in training candidates selected for fellowships, and several *in situ* training courses have been established. Over the whole of 1952 the United Nations will have spent $857,000 (some £306,000) on the I.C.A.O. technical aid programme, and next year's budget is $1,500,000 (£535,000).

BRINGING THE FARES DOWN

TOURIST services, first operated on May 1st this year, are now certain to become the economic basis of the airline industry. It is expected that, by April 1st, 1954, the majority of international airline passengers will be flying "second-class," with only a minority still using the more expensive first-class services. The change-over programme was unanimously agreed by the 67 I.A.T.A. airlines concerned during last month's Traffic Conference at Cannes, the results of which have just been announced. The decision to reduce fares on an international basis reflects the success of the North Atlantic experiment, involving reductions of 30 per cent on the standard summer return fares and 20 per cent on the cheaper off-season tickets. Extension of the tourist principle to all the world's air routes will take place in three stages. Economically, the North Atlantic routes formed an excellent proving-ground, and it would be too much to expect 30 per cent reductions on every route. Reductions will vary from route to route between the proportions of 15-25 per cent. Aircraft seating capacities will, of course, be increased to offset the reduced revenue per passenger; it has been estimated that half of the airlines' international fleet of 2,500 aircraft will be modified to high-density standards. In 1953 there should be at least 5 million more seats available. To assist the required build-up of traffic, as already announced in *Flight* (November 21st), I.A.T.A. airlines will pay an increased rate of commission to travel agents.

April 1st, 1953, will see the inauguration of tourist services within Europe and between Europe and the Middle East "gateways"—Amman, Beirut, Cairo, Damascus, Instanbul, Haifa, Jerusalem, Tel-Aviv-Yafo, and Nicosia (Cyprus). Aircraft used on the new European cut-fare services will have a minimum of 30 seats; individual baggage allowances on such flights will be reduced to 33 lb (or 44 lb when the first-class single fare is over £50). Reduced return fares do, of course, already apply to numerous off-peak services, in the case of which further reductions will be authorized when they are operated on a true "tourist" basis. One of the most significant advantages open to the European passenger is likely to be the reduction in single fares, enabling him to combine the advantages of air and surface travel. Agencies will also have a wider scope when planning tours.

The next stage, from October 1st, 1953, will be the extension of tourist services from the Middle East gateways to India, Pakistan and Ceylon and between Europe and South Africa (both direct and *via* the Middle East). The problems of certain operators with obsolete aircraft who offer slower services between Europe and the Middle East and West Africa will be met by the introduction of "Class B" services, at fares 10 per cent below tourist levels.

Both concessions have been anticipated by the recent introduction of, respectively, B.O.A.C. Hermes tourist services and "colonial coach" services (by British independent operators) on routes between the U.K. and Central Africa. The Cannes decision, therefore, simply "legalizes" unilateral British action by enfolding it in the I.A.T.A. framework of rates and fares. There will be a £5 increase in the single fare (now £175) between London and Johannesburg; presumably B.O.A.C.'s Comets will continue to operate high speed first-class services between the two points, and flights by increased-capacity Constellations and, possibly, Hermes will be 23 per cent cheaper. If so, this route will provide the first example of a trend frequently forecast: the use of jet-airliners for high speed first-class services with slower, high-density aircraft operating alongside.

Finally, on April 1st, 1954, second-class air travel will be extended to the Far East gateways of Hongkong, Manila and Tokyo, and across the Pacific from Asia and Australasia to San Francisco and Vancouver, and on to South America. To be held in the Western Hemisphere in November, 1953, the next Traffic Conference will determine the actual fare reductions involved in completing the global network of cut-fare services.

During the coming year there will be few changes in the existing pattern of first-class and tourist fares. As a result of experience on the North Atlantic routes I.A.T.A. has decided to permit the service of simple and inexpensive meals on long-distance tourist services without separate charge to the passenger. Accordingly, there will be slight increases in fares—$5, for example, on a single ticket between New York and London.

H.R.H. THE DUKE OF EDINBURGH flew to Luqa Airport, Malta, from London Airport on November 26th in an Elizabethan-class Airspeed Ambassador of B.E.A. The aircraft which made the flight was G-AMAB "Sir Francis Bacon," shown above flying the Duke's personal standard. The aircraft was under the command of Capt. W. Baillie, B.E.A.'s chief flight captain, who is on the extreme left; his crew consisted of (left to right): Captain E. L. R. Poole, Captain J. W. W. Cooke, Chief Radio Officer I. A. Dalgliesh, Radio Officer D. Cast, Engineer C. E. Corne, Engineer I. Thomas, Engineer J. Shepherd, Chief Steward E. B. Horniblow, First Class Steward J. Ellis-Baker and Flight Stewardess Pamela Rome. The Duke was due to return to London by Elizabethan on Tuesday, calling en route at Rome, where the Duchess of Kent was to board the aircraft.

CIVIL AVIATION . . .

Atlantic fares will otherwise remain basically unchanged. On April 1st a 10 per cent increase will be permitted on first-class fares between Rome and Athens and Istanbul, and on October 1st standard fares on through routes from Europe to the Middle East and India will go up by 5 per cent. World air cargo rates will not change significantly during the new "traffic year," but in February there will be a special meeting to discuss ways of developing extra cargo traffic over the North Atlantic.

AERLINTE—SEABOARD AGREEMENT

DETAILS have been announced of the agreement, between Aerlinte Eireann, Tta., and Seaboard and Western Airlines, Inc., under which Irish transatlantic air services will be opened on April 1st, 1953. Aerlinte, originally formed in 1946 to operate transatlantic services, is a subsidiary of Aer Rianta, which holds all the share capital (together with 60 per cent of the share capital of Aer Lingus). Five Constellations were bought in 1947, with the intention of opening services in the spring of 1948. Plans were suspended, however, by the Government of Eire, and the Constellations were sold to B.O.A.C. at a profit of nearly £400,000. Although it never operated any scheduled services, Aerlinte is still in existence (its assets total £1,880,000) and its licence to operate on the North Atlantic route has never been revoked. The agreement with Seaboard and Western will enable Aerlinte to open tourist services between New York, Boston and Shannon, without investing in new aircraft or training aircrews.

During the peak season there will be six round trips weekly between these points, initially with specially equipped DC-4s, to be replaced in the summer of 1954 when Seaboard take delivery of their four Super Constellations now on order. The aircraft will be registered in Ireland and will carry the markings of Aerlinte, which will be responsible for control of operations, sales and traffic. Crews will be American, but Aerlinte will probably provide hostesses.

During the period of agreement, which extends to the end of 1956, Seaboard and Western expect to earn approximately $11m (£3,930,000) revenue from the transatlantic services. The company operates nine DC-4s on non-scheduled freight services over American domestic, Pacific and Atlantic routes. In the past five years its aircraft have flown some 20m miles and have made over 1,700 crossings of the Atlantic alone. The airline has, since 1947, been applying for certification as a scheduled transatlantic freight carrier, but its applications have been consistently refused by the Civil Aeronautics Board.

TURBULENCE CAUSED L.A.P. ACCIDENT

IN its recently published report on the accident to a de Havilland Rapide at London Airport on September 1st, the Accidents Investigation Branch of the M.C.A. states that the Rapide pilot, W/C. B. J. McGinn, lost control of the aircraft after encountering turbulent air caused by a Stratocruiser. There have, the report states, been many similar cases of light aircraft being put out of control after encountering turbulence created by the propeller wash of large aircraft either during take-off or landing approach.

Carrying eight passengers, the Rapide was making a five-minute pleasure flight under conditions approved by the airport authorities —*i.e.* the flight was dovetailed into routine traffic, using the second half of the runway in use (23L) for take-off and the first half for landing. Visibility was good and there was a surface wind of 15 kt. After a normal take-off the Rapide began a right-hand turn and on R/T instructions from control took up No. 2 position in the traffic pattern behind a Stratocruiser. The pilot (who stated that on final approach he kept well to the right in order to clear the slipstream of the larger aircraft) was not given permission to land until the Stratocruiser had landed and had reached the intersection of runways 23L and 15L (1,000 yd from the threshold of 23L). While turning to line-up with the runway, at a height of about 300ft and speed of 100 m.p.h. at half-throttle, the aircraft was rocked violently several times. Despite the efforts of the pilot to regain control, the Rapide lost height rapidly, struck a 6ft high wire fence on the airport boundary with its port wing, bounced on its nose and came to rest on the perimeter track 475 yd from the threshold of the runway. W/C. McGinn was thrown out and severely injured [we understand that he is now well on the way to recovery] and five of the passengers were less seriously injured. The investigators found no cause other than turbulence to explain the accident. The aircraft was airworthy and properly loaded and its documentation was in order; the pilot was properly certificated and experienced in piloting Rapides. The fact that weather conditions at the time were not unfavourable appears to have contributed to the accident: the report notes that in conditions of little or no wind the turbulence is likely to persist near the ground for an appreciable time.

CHARTER NOTES

DURING the week ended November 30th, aircraft of the larger British independent companies completed 149 load-carrying charter flights. This increase in activity was accounted for mainly by a further increase of traffic on the Berlin Airlift and by a spurt of concentrated flying by Eagle Aviation. Most of the extra flights were short-haul, and corresponding mileage was low: altogether, 81,950 miles were flown—72,150 during the course of 123 freight flights, involving the uplift of 735 tons of cargo, and 9,800 miles on 26 trips during which about 1,225 passengers were carried. These flights amounted to 220,000 freight ton-miles and 239,000 pasenger-miles (about 21,000 more ton-miles). The week's operations amounted to about 465 flying hours and to earnings estimated at £43,500.

Air Charter, operating a fleet of Yorks on the Berlin Airlift, flew about 1,150 passengers, in 23 flights to Hanover and took 376 tons of freight, in 47 flights to Hamburg. They also undertook their first charter flight for several months and flew 13,400 lb of parcel freight from Lyneham to Singapore for the Air Ministry, returning with a similar load. Skyways of London returned to Amsterdam from Bangkok with a load of miscellaneous freight for K.L.M.

Eagle Aviation, having sold its Yorks and relevant contracts to Skyways, is vigorously seeking work for its fleet of twin-engined Vikings and Dakotas. In the first week of the new policy (last week), Eagle did very well. Two Dakotas flew from Prestwick to Paris, between them carrying 11,000 lb of fluorescent tubing; two more flights with similar aircraft were made between Manchester and Dublin with 15,000 lb of Sunday newspapers; other Dakota trips were from Liverpool to Antwerp with 26 seamen and from Bologna to Copenhagen with 5,000 lb of vaccine. A Viking and a Dakota brought 46 seamen from Hamburg to Blackbushe.

Silver City's Bristol 170s flew five horses from Le Touquet to Blackbushe, 8,500 lb of oil equipment from Blackbushe to Tripoli, 19 tons of cheese from Le Touquet to Lympne, and made 60 freight flights, carrying 600,000 lb, from Berlin to Hamburg and Hanover.

BREVITIES

THE Minister of Civil Aviation stated in the Commons last week that the price asked for each of the 11 Solent flying-boats offered for sale was £35,000, but that "reasonable offers would be considered." The original cost of each aircraft, he said, was about £150,000.

* * *

During the six months ended October 31st, the number of passengers (43,785) who flew on B.O.A.C.'s North Atlantic services was 42 per cent greater than the total (30,817) for the corresponding period last year. The number who flew on "Mayflower" cut-fare services, operated by 68-seat Constellations, was 18,905, thus reducing by some 20 per cent the total number of travellers on first-class services. This does not necessarily reflect the extent to which tourist services will divert traffic from the first-class routes, if at all; the American fuel strike and subsequent fuel shortage was responsible for a reduction in North Atlantic services at the beginning of the six-month period concerned and first-class routes were in some cases more seriously affected.

* * *

Reduced eight-day return fares of, respectively, £10 and £8 10s were introduced by B.E.A. on the services from London to Belfast and the Isle of Man services on December 1st. Normal monthly return fares for these two routes are £13 and £10 10s. Similar reduced fares were recently introduced on the routes between London and Scotland and have proved very popular. During the past four weeks, traffic between London and Edinburgh has been nearly four times as heavy as that during the same period last year.

* * *

The first de Havilland Comet to be built for France, one of three Series 1 as ordered by Union Aéromaritime de Transport made a 1¼ hr flight on November 25th carrying the French Ambassador in London, M. Rene Massigli, and Madame Massigli. Also aboard the aircraft, which was piloted by John Cunningham, were M. Loubry, a director of U.A.T., the Ambassador's counsellor, his private secretary and the air attaché to the French Embassy.

* * *

An order for four Convair 340s has been announced by a Brazilian operator, Servicos Aeros Cruzerio do Sul. Meanwhile the company has sold two of its DC-4s to California Eastern Airways, which will use them on its Pacific airlift services between Oakland Municipal Airport and Tokyo on behalf of M.A.T.S.

the way ahead

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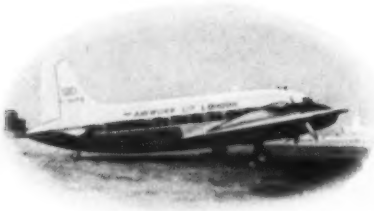

Leaders in private enterprise air transport since 1929, Airwork Ltd. continues to develop along the most modern lines. Airwork's claim to be the largest organisation of its kind in the world is further substantiated by recent forward steps. With the purchase in 1947 of a fleet of Vickers Vikings, Airwork became the first independent operator to fly post-war aircraft. On many Trooping, Army and Sudan Government Leave Services, on the transport of oil company personnel and equipment, these and other Airwork aircraft have been busily engaged for some years past. Now Airwork, in conjunction with Hunting Air Transport, has established the first post-war private enterprise airline — the Safari Service to East Africa. Airwork "looks forward" to further developments, of course.

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FROM THE CLUBS

THE annual dinner of the Association of British Aero Clubs in London on November 27th was chosen as the occasion for a most encouraging announcement on financial aid for private flying and towards national practical airmindedness. Details of the new scheme and also of a cup for which clubs will compete are given below.

In the absence through ill-health reasons of Mr. Lennox-Boyd, Minister of Civil Aviation, Mr. John Profumo, O.B.E., the new Parliamentary Secretary to the M.C.A., proposed "The Association of British Aero Clubs and Centres." After recalling that in pre-war days he was a pilot member of the Warwick and Leamington Aero Club, he went on to say that the annual report of the A.B.A.C. was encouraging and that ten firms had so far been enterprising enough to take part in the "business houses" flying clubs scheme. He thought the Association was on the right lines in bringing about uniformity of training methods and standards. Mr. Profumo then read the announcement regarding the new complementary scheme for A.T.C. flying with club pilots. After delivering his speech he had to leave at once for the House, in company with Mr. Lindgren and Mr. Geoffrey de Freitas, who is a vice-president of the Association.

Responding, Viscount Runciman of Doxford, A.B.A.C. president, felt that the new scheme would receive an enthusiastic response. The average cost of Auster flying—to quote "statistical fiction," was £2 16s an hour. With the new grant this would mean that only 11s remained to be paid by the pilot. He regretted the absence of Lord Pakenham and Sir Lionel Heald, both vice-presidents of the Association, but he voiced the Association's thanks to them, and also to the present Minister, Mr. Lennox-Boyd, for the trophy which he was personally to present for annual competition for the most efficient club.

Parodying a remark of the late Mr. Bevin, Lord Runciman said that we might be air-minded but he doubted if we were air-conditioned. We must do more to educate those who would be at their best flying age 15 years from now, so that they thought of flying as one of the natural careers. If, as everyone hoped, there was no third war, where would the ready-made supply of pilots come from?

Mr. G. H. M. Miles, A.B.A.C. executive-committee chairman, in proposing "The Guests," said that although the M.C.A.'s new Parliamentary Secretary was very new to his appointment, he was certainly "air-conditioned" to private flying, and the scheme he had announced marked a red-letter day for the clubs. He welcomed also A.V-M. C. A. Stevens, S.A.S.O. of Home Command, which had co-operated so valuably in the A.T.C. Scholarship scheme. After speaking appreciatively of former ministers, Mr. Miles said that the A.B.A.C. must look to the M.C.A. for the sub-organization of the clubs. Sir George Cribbett was present to be thanked for his help, but unfortunately Mr. J. E. Keel, M.C.A. Under-Secretary, Safety and General, was absent; he had been largely responsible for standardization of P.P.L. requirements, abolition of photographs on licences, and negotiations with the Inland Revenue on tax relief for clubs. The Association's gratitude should also be expressed to three other M.C.A. officials, Messrs. A. H. Wilson, C.B., C.B.E., Under-Secretary (Air); R. W. N. B. Gilling, Head of Air Services C; and L. C. Nash, O.B.E., Head of A.S.C.2.

Mr. Miles said the A.B.A.C. would be very sorry to see the Ministry abolished. There had been early troubles in pre-Pakenham days, but now he thought that there was a refreshing wind of realism; he hoped that if the Ministry were abolished it would at least be preserved as an entity in some other department.

Next, Mr. Miles welcomed the two F.N.A. representatives who had come specially from France for the dinner, and went on to speak with regret of the absence of Mr. Cecil Field, who was ill; his company's (Shell's) gift of £1,500 had been invaluable to the Association and had tided it over when it had few friends.

In his reply to the toast A.V-M. Stevens said that the R.A.F. thought the clubs had done a very good job in giving air experience to cadets and in operating the A.T.C. Scholarship Schemes. Up to the end of October over 1,000 scholarships had been granted and 34 clubs had already taken 632 of those concerned up to P.P.L. standard, with an aptitude-wastage of only 9.3 per cent. Selection standards were about to be improved with a view to reducing wastage further. Of the cadets trained by clubs, 225 had so far entered R.A.F. aircrew training and 48 had gained their wings.

The new scheme would give better and more varied air experience to selected cadets. A.V-M. Stevens hoped that club pilots would not take their important task too lightly, and that the results would make it desirable to extend the scheme.

A final brief speech was made by M. R. Pellevoizin, president of the F.N.A. of France. He thanked the Association on behalf of five hundred French clubs, and he congratulated it on its magnificent organization; France was working for the same ideals but lacked resources for the many branches of flying—gliding, ultra-light aircraft, parachute training, and so on. He hoped to see many more English pilots visiting French clubs: "The brotherhood of wings recognizes no national boundaries nor those of age," he said.

THE pleasant practice of organizing House Dinners at the Royal Aero Club has been revived, and the first, on Wednesday, November 26th, was given in honour of Mr. Philip Wills, world gliding champion, and the British Gliding Team of 21 members. Lord Brabazon of Tara, president of the Club, proposed the principal toast, and Mr. Wills replied. Mr. Wills spoke of national airmindedness, citing Germany in the early '30s as an example. In Britain, he said, everyone should have an opportunity to develop airmindedness, though not everyone necessarily as a pilot. Farnborough Displays led to a *sort* of airmindedness, but gave an impression of "superman stuff." He was in favour of the gliding method of letting everyone fly. A woman or boy of 14 who flew still got his name into the paper; this country would be airminded when one got one's name in the paper if one did *not* fly. Earlier, talking of costs and support for the gliding movement, Mr. Wills had said that the cost of a pair of flaps for a modern bomber would be sufficient to stabilize the gliding movement.

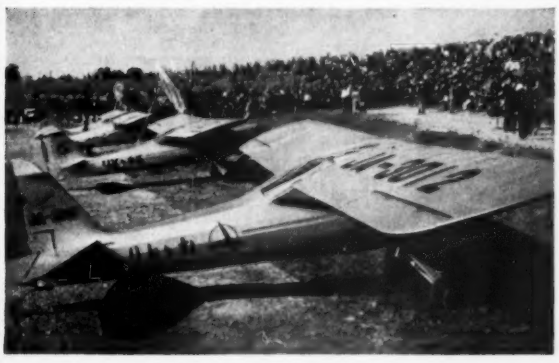
During the evening Mr. Profumo, the new Parliamentary Secretary to the M.C.A., was able to leave the House in order to spend a few minutes with Aero Club members and their guests; this was his first engagement since his appointment.

At the end of the dinner Mr. Stanley Dickson, B.G.A. Council-member, presented to Mr. Wills on behalf of the Derbyshire and Lancashire Gliding Club a rather-the-worse-for-wear Union Jack which had become something of a symbol during the International Gliding Contests. He offered it both as a souvenir and a talisman for the future. He told the story of how it was procured at short notice from the London and South American Bank in Madrid, all other sources—including the British Embassy—having been unable to provide one.

Mrs. Ann Douglas, captain of the team, thanked the Aero Club for their hospitality and, finally, Mr. F. N. Slingsby, maker of the successful Sky sailplanes, was prevailed upon to speak. He said that, being a Yorkshireman, he had expected the team to succeed. He was glad that it had not been necessary to use German machines any longer, and he hoped that next time he would be providing an even better sailplane for the British team.

The dinner followed a reception in honour of Mr. Wills and the team, given by Viscount Kemsley, president of the B.G.A., at Chandos House, his London residence.

THE important new Air Ministry plan—referred to above—for assisting the flying clubs was officially announced on November 27th. Club resources will be used to give "more stimulating and profitable air experience to selected cadets of the A.T.C. and Combined Cadet Force (R.A.F.) than they can be expected to get from passenger flights in R.A.F. Anson aircraft." Such flights will be given by suitably qualified club pilots who, in return, will be paid at the rate of £2 5s per hour. For the present the scheme will be confined to those clubs which are already participating in the training of A.T.C. cadets selected for "flying scholarships." Instruction, in the normal sense, will not be given under the new scheme; cadets will not be allowed to take over the controls, and pilots will be forbidden to perform aerobatics. The use of controls will be demonstrated, however, and cadets will obtain elementary practice in map-reading.



HEIR DISPLAY: Three Aiglets and an Autocar, bearing Japanese markings; they were photographed on the occasion of the display (reported on page 692) given at Tokyo in honour of the newly proclaimed Heir-apparent.

SERVICE AVIATION

Royal Air Force and Naval Aviation News

R.A.F. Coronation Review

IT was announced in the House of Commons last week that the Queen had approved plans for an R.A.F. Coronation Review, to be held on Wednesday, July 15th, 1953. Making this official announcement, Mr. George Ward, Under-Secretary of State for Air, said that details would be published later.

R.A.F. Appointments

WITH effect from February 5th, 1953, A.V-M. G. Combe, C.B., is to become A.O.C. No. 41 Group Maintenance Command. His present post of A.O.A. at Maintenance Command H.Q. will be taken by A.V-M. H. G. White, C.B., C.B.E.

A.V-M. White has been A.O.C. No. 41 Group since November, 1950; he previously commanded No. 43 Group.

Until recently Group Captain (Training) at H.Q. Transport Command, G.C. W. K. Beisiegel, O.B.E., will take up a new appointment this month as A.O.C. Transport Wing, Middle East Air Force, with the acting rank of air commodore.

Canadian War Honours

A LIST of 33 battle honours—headed by the Battle of Britain—won by the R.C.A.F. during the Second World War has been approved by Her Majesty the Queen.

The list includes those air battles in which Canadian squadrons participated, but none in which personnel of the R.C.A.F. were engaged while serving with the R.A.F. is included unless R.C.A.F. units participated in the same engagement. The list is correlated with the battle honours of the R.A.F., as approved by King George VI.

The histories of all participating Canadian squadrons are now being reviewed so that each may be awarded the honours to which it is entitled. The battle honours awarded will be displayed in the form of a plaque headed by the squadron badge and number, followed by the list of honours won. If, at a later date, squadron colours are introduced the honours will be embroidered upon it.

TYPE 171 Mk 50 is the official designation of this latest Bristol helicopter, now in production for the Royal Australian Navy. Compared with earlier Type 171s the machine has a lengthened undercarriage, lower door threshold, side exhaust and hydraulic winch. (See paragraph below).

New Variant of Bristol 171

ILLUSTRATED on this page is the Bristol 171 Mk 50 helicopter now in production at Filton for the Royal Australian Navy. The type is intended for air sea rescue and communications and various modifications have been introduced. For air sea rescue work there is a hydraulically operated winch on the starboard side, power for which is provided by a pump on the main-rotor gearbox. The rescuer, who is lowered in a special Bristol-designed harness, secures the "rescuee" by passing a bandolier under his armpits, and throughout the operation he keeps in touch with the cabin by intercom. The winch is mounted abaft an open doorway, which is covered by a quick-release curtain while the helicopter is flying to and from the scene of a rescue. To give maximum freedom of movement the door threshold is at floor level, and the floor itself is flat and covered with a rubber tray to prevent sea water draining from the clothing of a rescued man and into the fuselage structure. The normal seats at the rear of the cabin are replaced by folding seats of deck-chair type, giving more working space for winch operation and the taking of rescued personnel aboard.

The new undercarriage gives an additional 9in ground clearance and a side exhaust is fitted to avoid burning or scorching when landing in scrub or on a deck. The instrument-panel layout has been modified and an F.24 camera can be installed in the floor. In the communications rôle the winch is removed and the fuselage aperture on the starboard side covered by a metal panel containing a knock-out Perspex escape hatch.

DOWN ON THE RIO GRANDE: A Canberra of the R.A.F. Goodwill Mission to South America disporting itself over the famous Rio de Janeiro beaches. On Tuesday the four Canberras were to attack the record for the west-east crossing of the South Atlantic and, continuing via West Africa, are due back at Binbrook today, December 5th.

New R.A.F. Squash Champion

LAST week, at the Lansdowne Club, London, the R.A.F. Squash Rackets Championships was won by Cpl. A. E. Catherine, physical training instructor at Cranwell and at one time a squash professional. He beat W/C. A. R. Collins decisively in the final, the scores being 9—5, 9—2, 9—2. G/C. B. K. Burnett, champion for the past three years, was beaten by Cpl. Catherine in the semi-finals (9—4, 3—9, 5—9, 9—1, 9—0) and W/C. Collins just managed to dispose of W/C. Beamish 9—7, 8—10, 7—9, 9—5, 9—1. Others in the last eight (and, bracketed, their successful opponents) were a promising young player, P/O. R. L. Lees (Burnett); F/O. A. A. Ramus (Catherine); W/C. T. N. Stack (Beamish); and S/L. N. G. S. Marshall (Collins).

10,000 Meteor Sorties

SINCE converting to Gloster Meteors from Mustangs in July, 1951, No. 77 Squadron, R.A.A.F., have flown more than

Shorts announce

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IF IT'S CARAVANS—IT'S MONTROSE

SERVICE AVIATION . . .

10,000 sorties. In addition to making fighter sweeps in "Mig Alley," No. 77 have used their Meteor 8s for ground attacks and escorting U.S. bombers.

R.C.A.F. in Europe

AT a ceremony to be performed shortly before the North Atlantic Council meeting opens on December 15th, Mr. Brooke Claxton, the Canadian Defence Minister, will formally place Canada's overseas air force units within the Atlantic Pact command of General Matthew Ridgway in France.

Back on the Job

THE light fleet carrier, H.M.S. *Glory*, commanded by Capt. T. A. K. Maunsell, R.N., is now back for operational duties in Korean waters—for the third time.

During the first eight flying days, air operations were continuous from dawn to dusk and 432 sorties were flown. The main targets were enemy supply lines.

Glory's air group is made up of No. 801 Squadron, R.N., commanded by Lt.-Cdr. P. B. Stuart, R.N., flying Hawker Sea Furies, and No. 821 Squadron, R.N., which flies Fairey Fireflies and is commanded by Lt.-Cdr. J. R. N. Gardiner, R.N.

R.A.A.F. College Exchange Scheme

NEXT year, under an exchange scheme recently announced, graduates of the R.A.A.F. College at Point Cork, Australia, will come to Britain and graduates of R.A.F. College, Cranwell, will go to Australia.

The first four graduates to come to Britain under this scheme are now completing a tour of operational flying with No. 77 Squadron, R.A.A.F., in Korea. Later in the year they will be followed by a number of navigators now serving in Malaya.

It has been decided not to exchange graduates immediately on their passing out from college, because it is considered that future permanent officers should have at least a year's operational service before taking up exchange duties.

Exchanges will be for two years and R.A.F. officers will be available for operational employment wherever Australian units are serving, just as R.A.A.F. officers posted to Britain may be required to serve on the Continent.

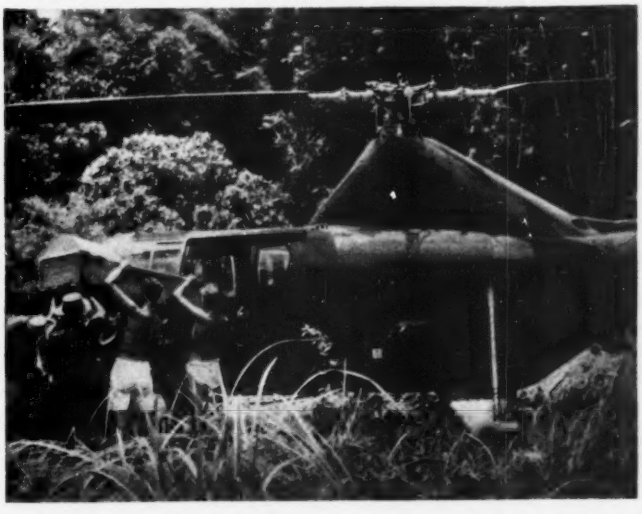
SMOKY JOE: As Lt. Joseph J. MacBrien touches down in a Grumman Panther of Fighter Squadron 781, U.S. Navy (the arrester hook can be seen engaging a cable) smoke streams from the tyres. The Panther appears to be of the F9F-5 series, powered with a Pratt and Whitney J-48 (Rolls-Royce Tay licence). Lt. MacBrien is an exchange pilot from the Royal Canadian Navy.

R.A.F. Reserves Club Luncheon

THE recently appointed Vice-Chief of the Air Staff, Air Chief Marshal Sir John Baker, was the principal guest at a luncheon given by the Royal Air Force Reserves Club in London on Wednesday, November 26th. Air Chief Marshal Sir Guy Garrod was in the chair, and S/L. W. A. G. Goldsworthy was warmly welcomed back after his illness.

After lunch, Sir John Baker gave a talk on the Middle East—he was until recently C-in-C. M.E.A.F. His ability to give such a clear outline of Middle East strategy, developments in the area and of the major part played there by the R.A.F., all in the course of a thirty-minute extempore talk, is undoubtedly indicative of an exceptional grasp of the subject, which may well prove of the greatest importance in his new appointment.

CLOSE QUARTERS: A Westland Sikorsky Dragonfly of the Far East Air Force Casualty Evacuation Flight picks up a casualty from a jungle clearing in North Perak. Jungle trees, which have to be cleared in a jump start, are in some places over 160ft high.



Use of Naval Helicopters

A FILM taken by Mr. William Courtenay during Exercise Mainbrace, and shown last week at the Royal United Service Institution, illustrated the manifold uses of a naval helicopter.

Sequences showing helicopters landing on or leaving various types of warships demonstrated how quickly a meeting of ships' captains could be assembled even in a widely dispersed fleet, or how a fleet commander could visit units under his command without appreciable absence from the flagship.

The film dealt only with helicopters operating from the American element participating in Mainbrace, as no helicopters were available to the British forces.

The absence of British helicopters was shown to be particularly noticeable when a fighter of the Royal Navy force landed in the sea and a request had to be made to an American carrier, steaming some miles away, to send a rescue helicopter.

Transport in Malaya

NOW that the R.A.F. Valetta squadrons are able to meet the air-transport requirements in Malaya, No. 38 Squadron, R.A.A.F., which has been operating there for over two years, is to return to Australia. The withdrawal of No. 38 Squadron will not affect the Australian Lincoln bomber squadron, which will continue on operations against the terrorists.

Per Ardua Motor Club

WITH the object of fostering an interest in motoring, especially on the sporting side, the Per Ardua Motor Club has been formed. S/L. H. J. McRae, Room 3360, Air Ministry, Whitehall, London, is the honorary secretary.

Squadron Tie

IT is announced that ties are now available for past and present members of No. 540 (P.R.) Squadron. They are obtainable, price one guinea, from The Adjutant, No. 540 Squadron, R.A.F. Benson, Oxon.

THE INDUSTRY

The Versatile Eye

THE Dowty "magnetic-eye" indicator, used in aircraft as a tell-tale to the working of a wide variety of services, has found a new application in the D.H. Comet. It is being employed for the testing of fire-extinguisher circuits.

In the past it has been usual to apply circuit tests by means of "prods," utilizing a suitable instrument incorporating the necessary low-voltage supply and meter. In addition to the work involved in the provision of working platforms and removal of engine cowlings, extinguisher bottles were sometimes fired inadvertently, necessitating the complete cleansing of engine and bay.

With the Dowty magnetic indicator, which incorporates a specially high resistance, the pressing of a push-button in the cockpit is all that is necessary and provides immediate visual indication of the test result, and, because of the high resistance, there is no danger of the bottle operating accidentally.

Of the "eyeball" type, the indicator is actuated from a direct current source, normally 28 volts. It has a temperature operating-range of +50 deg to −65 deg C, and compass interference is stated to be negligible. Total weight is 1.57 oz.

Keeping Dirt Under Control

ONE of the many important but less spectacular aspects of airliner-maintenance is that of cleaning cabin-interiors—a job which demands the right equipment if it is to be executed efficiently.

From New Welbeck, Ltd., 94 New Bedford Road, Luton, Beds—who are specialists in the manufacture of industrial suction-cleaners—comes a brochure illustrating their "Simplex", "Duplex" and "Triplex" types of equipment performing a variety of tasks, among which is seen the interior cleaning of a B.O.A.C. Stratocruiser.

The range of models available covers supply voltages from 24 to 250, A.C. or D.C., and there is a wide selection of brushing, suction and blowing attachments. A particular point is made of the fact that there is no dust-bag, the dirt being filtered into a metal container. Each machine runs on a detachable trolley provided with three ball-bearing casters.

Design of Miniature Bearings

TECHNICAL considerations in the design and operation of gyroscope-rotor bearings are discussed in considerable detail in *RMB Communication Two*, a memorandum published periodically by Miniature Bearings, Ltd., 192, Sloane Street, London, S.W.1. New developments described include an oil reservoir with capillary seal, and races which automatically take up play at speed; both are in production. Also discussed are bearings in which the rotor-spindle is actually supported on a cushion of compressed air supplied through a number of very small orifices radially disposed round the bush. North American Aviation have successfully used bearings of this type for gyros in guided missiles. A description follows of "air bearings" which RMB are now developing.

Large-diameter Flexible Ducting

FOLLOWING a considerable period of development-work carried out in conjunction with the Ministry of Supply, Bells Asbestos and Engineering Ltd., of Slough, Bucks, have standardized two types of large-diameter flexible ducting for use principally in connection with various types of equipment for heating and cooling aircraft. One is a double-wall, air-insulated concertina hose; the other is a simple single-wall hose. The former, subject of a "Bestobell" patent, has been adopted for Service use; the other was produced for civil aircraft and has found many other applications.

The double-wall concertina hose consists of an inner C.2 Hycar-coated asbestos cloth tube which is attached to a helical spring-steel coil at four points on the circumference of each turn, thus forming a square, while the outer cover—usually a waterproof canvas—is carried on the outside of the coil. This construction provides air spaces in the segments formed between the inner square and the outer circular cover.

The single-wall concertina ducting is a simple asbestos-cloth sleeve supported internally by a helical-spring coil attached to the sleeve at the ends. Other materials can be used in each type of hose.

The normal diameter-range is from 5in to 12in for both types, and the hoses can be collapsed to approximately 1½ in per foot for storage purposes. Maximum operating temperature limit is in the order of 300 deg F—the limiting temperature of the Hycar proofing—but ducts made of asbestos cloth can operate at up to more than 800 deg F.

(Canadian Pacific photograph)

CANADIAN AWARD: Mr. Phil C. Garratt of Toronto receives the McKee Trophy from Air Marshal W. A. Curtis, R.C.A.F. chief of staff, at the McKee Trophy presentation dinner held in conjunction with the annual meeting of the Air Industries and Transport Association. Mr. Garratt, managing director of de Havilland Aircraft of Canada, received the trophy—awarded annually in recognition of work furthering Canadian aviation—for his development of the D.H.C. Beaver and Otter.

Guide to British Electrical Equipment

PUBLICATION of the second edition of *The BEAMA Catalogue* marks a further stage in the British electrical industry's contribution to the nation's economy. Published for the British Electrical and Allied Manufacturers' Association, the Catalogue is accepted throughout the world as the authoritative buyers' guide to the complete range of products of Britain's electrical industry.

A notable innovation in this second edition is a glossary in five languages—English, French, German, Portuguese and Spanish.

This 1952-53 edition, which is again published for the Association by Iliffe and Sons Ltd., contains 1,020 pages. Over 15,000 copies have gone to the buyers, distributors, public utilities and trade commissioners of every country overseas.

British Standards

THE British Standards Institution has published British Standard E.21, *Electric cables for aircraft (glass and polychloroprene insulated)*, specifying the requirements for the following four ranges of cables for use for wiring of aircraft circuits where the potential between conductors, or between a conductor and metal braid or the aircraft structure, does not exceed 250 V (r.m.s.) and 1,600 cyc/sec :—

(*a*) **Pren:** Cable with a copper conductor and an insulation of glass braid and polychloroprene compound, for single-core cables; twin and multicore cables have an overall finish of glass braid and lacquer.

(*b*) **Prenal:** Similar to the Pren range but with a conductor of aluminium instead of copper.

(*c*) **Prenmet:** Similar to the Pren range but with the addition of a metal braid.

(*d*) **Prensheath:** Twin and multi-core Pren cables sheathed with a polychloroprene compound in place of the lacquered glass braid.

Copies of this standard may be obtained at 3s. 6d. from the B.S.I. at 24, Victoria Street, London, S.W.1. The cables referred to are made by British Insulated Callenders Cables, Ltd.

IN BRIEF

Mr. H. L. Bowen, a technical executive of the valve division of Mullard, Ltd., was recently presented with a gold watch and a cheque to mark his completion of 25 years' service.

* * *

Heenan and Froude, Ltd., of Worcester, have received an important contract from the Associated Ethyl Co., Ltd., for engine-testing equipment in their fuel-research laboratories. It will include a number of dynamometers of various powers.

* * *

Consisting of no fewer than 108 pages of descriptive matter, illustrations and technical data, a most comprehensive catalogue entitled *Automatic Controllers* has been produced by Negretti and Zambra, Ltd., 122 Regent Street, London W.1. Intended mainly for industrial applications, the devices described fall broadly into the categories of temperature, pressure and humidity controllers, and much ancillary equipment is described.

* * *

Kenton Equipment, Ltd. (48 Brook Street, London W.1) have received an initial contract for the supply of their "B.O.A.C." hydrostatic weighing units to the R.C.A.F., and their sales manager, Mr. D. R. Ruscoe, is now in Canada, where he will visit aircraft manufacturers. He is also to go to the United States, where these Kenton units have been adapted for the purpose of gas-turbine thrust-measurement as well as for aircraft weighing.

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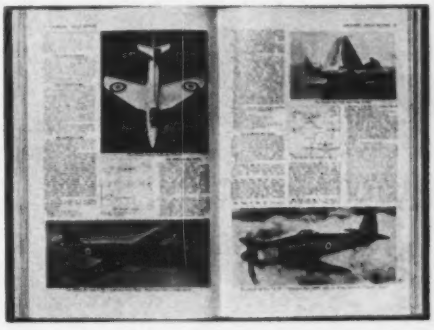

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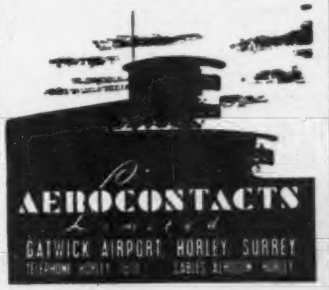

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 43 (further revised) from Airwork Ltd., of 15 Chesterfield Street, London, W.1, for a Colonial Coach service with Vickers VC1 aircraft, for the carriage of passengers and supplementary freight between London (Blackbushe) and Salisbury (Belvedere) with intermediate traffic stops at Lusaka and N'dola only, at an initial frequency of from one to two services weekly, during the period from November 1st, 1952 to October 31st, 1959.

APPLICATION No. 51 from Skyways Ltd., of 6/7 Berkeley Street, London, W.1, for a Colonial Coach service with York M.K.1 aircraft for the carriage of passengers, supplementary freight and mail between London (Blatsted) and Cyprus (Nicosia), with an intermediate traffic stop at Malta, at a frequency of from one service fortnightly up to one weekly, during the period from January 1st, 1953 to December 31, 1962.

APPLICATION No. 119 from Silver City Airways Ltd., of 1, Great Cumberland Place, London, W.1, for a Vehicle Ferry service with Bristol 170 aircraft for the carriage of Vehicles, supplementary freight and passengers between Southampton (Eastleigh) and Isle of Wight (Bembridge), at a frequency of from two to 28 services daily during the period from April 1st, 1953 to December 31, 1961.

FROM Olley Air Service Ltd., of Croydon Airport, Croydon, Surrey:—

Application No. 120 for a Normal Scheduled Seasonal service initially with DH.89, DH.Dove and Airspeed Consul, and later, possibly with DH.Heron aircraft, for the carriage of passengers, supplementary freight and mail between London (Croydon) and Deauville, at a frequency of from seven to 42 services weekly, during the period from April 1st, 1953 to September 30, 1959.

Application No. 121 for a Normal Scheduled Seasonal service, initially with DH.89, DH.Dove and Airspeed Consul, and later, possibly with DH.Heron aircraft, for the carriage of passengers, supplementary freight and mail between London (Croydon) and Le Touquet, at a frequency of from seven to 42 services weekly, during the period from April 1st, 1953 to September 30th, 1959.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 9 Buckingham Gate, London, S.W.1 from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, must reach within the period allowed for the making of representations or objections.

THE Council give notice that Application No. 86 from Airwork Ltd., of 15 Chesterfield Street London, W.1, for a Colonial Coach service between London and Salisbury with York aircraft which was advertised in "The Times," "The Aeroplane" and "Flight" on October 31st, 1952, has now been withdrawn. [8937A]

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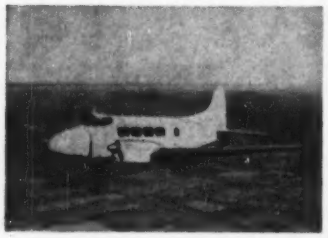

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SITUATIONS VACANT

BLACKBURN AND GENERAL AIRCRAFT LTD have an extensive and progressive programme of design and development work on

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necessitating expansion of the design organisation in the following categories:—

AERODYNAMICISTS:
Senior qualifications and experience on aircraft work essential.

STRESSMEN:
Senior and Intermediate grades with sound qualifications and aircraft experience.

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Senior Grade for planning of flight test programmes, flight test observing, and analysis of test results. Good aerodynamic background and previous experience essential.
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(b) Intermediate grade. Preferably with experience of aircraft test work, but applicants with a good engineering background will be considered.
Weights Control Section:
Aircraft experience desirable.

DRAUGHTSMAN:—
(a) Senior grade with aircraft experience.
(b) Intermediate grade. Preferably with aircraft experience, but applicants with light structural or mechanical experience will be considered.
(c) Electrical. Aircraft experience desirable.

DESIGN officers are at Brough and Leeds. Salaries will be commensurate with ability and experience, and every consideration will be given to ensure the widest scope for extension of experience and future prospects.

Write to
THE PERSONNEL SUPERINTENDENT,
BLACKBURN AND GENERAL AIRCRAFT, LTD.,
BROUGH, YORKS. [8967

CITY OF COVENTRY EDUCATION COMMITTEE
COVENTRY TECHNICAL COLLEGE

PRINCIPAL: H. V. FIELD, B.Sc., Wh.Sch., M.I.E.E.
MECHANICAL ENGINEERING DEPARTMENT

APPLICATIONS are invited for appointment as head of the above department, vacant as from May 1st, 1953. CANDIDATES should be honours graduates in engineering or equivalent, have had good industrial or service experience and be experienced teachers conversant with the work of a large engineering department in a major technical college offering a wide variety of courses in mechanical, production, automobile and aeronautical engineering.

SALARY in accordance with Burnham Technical Scale, Grade IV (£1,340 by £25 to £1,490).

APPLICATION forms and further particulars obtainable from the Director of Education, Council House, Coventry, to whom the completed forms should be returned as soon as possible. [8997

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Write to THE PERSONNEL SUPERINTENDENT,
BLACKBURN AND GENERAL AIRCRAFT LTD.
BROUGH, YORKS. [8966

EXPERIMENTAL ENGINEERS, ASSISTANTS AND DRAUGHTSMEN

are required by the English Electric Co., Ltd., for their Aircraft Division at Warton Aerodrome, near Blackpool, to fill vacancies in the engineering laboratory, arising from expansion of their activities. Engineers with experience of structural, mechanical, electrical and gun armament work are required. Although men with experience of test and development work are preferred, applicants with a sound background in one or more of the above fields will be considered. Qualifications required: degree or Higher National Certificate for senior posts. Ordinary National Certificate or equivalent for junior posts. Please reply, quoting Ref. EAP, to Central Personnel Services, English Electric Co., Ltd., Marconi House, 336-7 Strand, W.C.2. [8984

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APPLICATIONS are invited for a lectureship in aircraft structures and design. Salary scale: £500 by £50 to £1,100. The appointment will be made at a point in the scale corresponding to experience and qualifications. F.S.S.U. and family allowance benefits.

APPLICATIONS (5 copies) should be lodged, not later than January 31st, 1953, with the undersigned, from whom further particulars may be obtained.

ROBT. T. HUTCHESON,
Secretary of University Court. [8969

APPLICATIONS are invited for the following positions in the London area:—

DRAUGHTSMEN required for detail drawing of experimental designs of aircraft electrical equipment. Works experience essential. The positions are remunerated and give considerable scope to men with adequate experience.—Write, giving full details in strictest confidence, to the Employment Officer, Rotax, Limited, Chandos Road, Willesden Junction, N.W.10. [8981

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with a degree or H.N.C. for work on an interesting programme of mechanical, structural, electronic, hydrodynamic and thermodynamic testing. *These vacancies offer good scope for advancement to the right men.*

Help will be given toward obtaining housing accommodation.

Apply in writing to:—

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SITUATIONS VACANT

PILOTS

WEST AFRICAN AIRWAYS CORPORATION have vacancies for pilots to be appointed as junior captains and invite applications from pilots who hold a current Airline Transport Pilot's Licence. West African Airways Corporation have an expanding fleet of Marathon, Dove and Wayfarer aircraft.

SALARY according to qualifications and experience within the range of £1,400 per annum and £1,900 per annum.

FREE fully furnished accommodation is provided in West Africa, but married men on initial engagement may be required to serve for a few months before being joined by their families.

FREE return passages are provided each tour for the employee, his wife and up to two children, not exceeding 18 years of age.

TOURS of duty will be from 12 to 15 months with leave on full salary at the rate of one-fifth of the period of service in West Africa.

CONDITIONS of service will include membership of a pension scheme allowing retirement at 65, subject to a minimum of 10 years' service. (Retirement five years earlier may be arranged by mutual agreement.) In the case of employees not completing 10 years' service, a gratuity arrangement exists whereby subject to a minimum of four years' service, a payment at the rate of £150 for each full year of service will be made on termination of appointment.

A COMPREHENSIVE contributory medical scheme exists for employees and their families.

APPLICATIONS should be submitted to the local Agents of W.A.A.C., B.O.A.C., Airways House (Room 108) Great West Road, Brentford, Middlesex. [0740

RADIO OFFICERS.

WEST AFRICAN AIRWAYS CORPORATION have vacancies for radio officers. Essential qualifications include possession of current M.C.A. 1st class flight radio telegraphy operator's licence.

SALARY according to qualifications and experience within the range of £1,100 per annum to £1,300 per annum (all-in).

IN lieu of benefits from a pension scheme, radio officers receive a bonus of £37/10/- for each completed three months of service.

FREE fully furnished accommodation is provided in West Africa, but married men on initial engagement may be required to serve for a few months before being joined by their families.

FREE return passages are provided each tour for the employee, his wife and up to two children, not exceeding 18 years of age.

TOURS of duty will be from 12 to 15 months with leave on full salary at the rate of one-fifth of the period of service in West Africa.

APPLICATIONS should be submitted to the Local Agents of W.A.A.C., British Overseas Airways Corporation, Airways House (Room 108), Great West Road, Brentford, Middlesex. [0741

HANDLEY PAGE, Ltd., have vacancies for:—

AERODYNAMICISTS of degree standard or with H.N.C. in aero subjects. Previous experience preferred.

STRESSMEN of degree standard or with H.N.C. in aero subjects. Previous experience preferred.

SENIOR design and intermediate draughtsmen, preferably with aircraft experience for Cricklewood and Radlett offices. Consideration will be given to applicants with experience in light structural or mechanical engineering. Possession of O.N.C. or H.N.C. (Mech. or Elect.), an advantage.

WEIGHT control engineers with O.N.C. (Mech.). Previous experience preferred.

TECHNICAL assistants of degree or H.N.C. (Elect.) standard for the design and development of aircraft electrical systems. Previous experience preferred.

WRITE, stating age, qualifications and details of experience, to Staff Officer, Handley Page, Ltd., Cricklewood London, N.W.2. [0034

AIRWORK Ltd., has overseas vacancies in its Viking Fleet for the following categories of aircrew (male):—

CAPTAINS. Airline Transport Pilot's Licence, with Viking endorsement an advantage. Salary £1,300-£1,980 per annum, according to experience.

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FLIGHT ENGINEERS. "A," "C" and "O" Licences covering Viking aircraft and Hercules engines an advantage, but any combination of these licences considered. Salary according to qualifications from £740-£1,230 per annum.

ALL the above appointments carry with them generous overseas allowances, pension schemes, personal accident insurance according to salary, and regular annual increments.

APPLICATIONS in writing, giving full particulars and qualifications, to Aircrew Superintendent (OS), Airwork, Ltd., Blackbushe Airport, Nr. Camberley, Surrey. [0046

APPLICATIONS are invited for the following positions in the London area:

DEVELOPMENT engineers required by manufacturer of A.C. and D.C. electrical equipment for aircraft. Applicants should hold at least a Higher National Certificate or preferably an engineering degree. The positions are superannuated and give considerable scope to men with adequate experience.—Write, giving full details in strictest confidence, to the Employment Officer, Rotax, Limited, Chandos Road, Willesden Junction, N.W.10. [0002

VACANCIES exist for experienced pilots and radio operators. Permanent staff.—Apply, Transair, Limited, Croydon Airport, Surrey. CROydon 7686. [0030

SENIOR airframe design draughtsman required for structural work on new aircraft.—Applications, in writing to Chief Designer, Auster Aircraft, Ltd., Rearsby, Leicester, or to local Labour Exchange. [0049

ELECTRONICS engineer required for guided weapon project by engineering company, one hour of London. Superannuation scheme.—Write in confidence, giving details of experience and salary required, to Box 3002. [0043

LICENSED radio engineer and radio mechanics at our base at Stansted Airport, Essex. Apply by letter or telephone to the Senior Radio Engineer, Aviation Traders, Ltd., Southend Airport, Essex. Tel.: Rochford 56491. [0060

TECHNICAL illustrator required, aged 23 or over, with considerable practical experience.—Applications, in writing, to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds., stating age, experience and salary required. [0033

AIRCRAFT or mechanical draughtsmen required, all grades. Apply, stating age, experience and salary required, to The Chief Draughtsman, Alan Muntz and Co., Ltd., Aircraft Division, Langley Aerodrome, Slough, Bucks. [0025

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SITUATIONS VACANT

PROCESS engineers and tool planning engineers with minimum of 5 years aircraft experience in these occupations required for special duties on methods section.—Write fully to Personnel Supervisor, Hawker Aircraft, Ltd., Canbury Park Road, Kingston-on-Thames. [9936]

APPLICATIONS are invited for the position of secretary to company secretary. First-class qualifications, good speed shorthand/typing and aviation experience essential. Letters only to Skyways, Ltd., 11 Berkeley Street, W.1. [9973]

HANDLEY PAGE, Ltd., have a vacancy at their Radlett (Herts) Aerodrome for a flight observer. Previous experience in this type of work essential.—Write, stating age and full details of experience, to Staff Officer, Handley Page, Ltd., Cricklewood, London, N.W.2. [9964]

GLOSTER AIRCRAFT Co., Ltd., have vacancies for aircraft design draughtsmen and electrical draughtsmen.—Write, giving full details of previous experience, age and salary required, to Employment Officer, G.A.C., Ltd., Hucclecote, Glos. [9916]

JIG and tool draughtsmen, fully experienced, required by Percival Aircraft, Ltd., Luton Airport, Beds. Good working conditions and full welfare facilities, including staff pension scheme.—Applications to the Personnel Manager, stating age, experience, salary required. [9909]

SENIOR centre schedule clerk, capable of taking charge of on replication section, required by Percival Aircraft, Ltd., Luton Airport, Beds. Good welfare facilities, including staff pension scheme.—Applications, in writing, to Personnel Manager, stating age, experience and salary required. [9997]

LANCASHIRE AIRCRAFT CORPORATION, Ltd. (Skyways of London), are now appointing additional navigating officers for their York fleet.—Applications from holders of appropriate M.C.A. licences should be made in writing to the Personnel Manager, Bovingdon Airport, Herts. [9899]

H. M. HOBSON, Ltd., invite applications for positions in the drawing office as follows: designers, detail and modification draughtsmen, checkers, assessors. The work is concerned with interesting projects connected with fuel metering equipment and hydraulic flying controls for aircraft.—Hobson Works, Fordhouses, Wolverhampton. [9849]

OPPORTUNITIES are offered to experienced draughtsmen and designers in the aero gas-turbine field to deal with blade design, engine design, fuel and control systems and weight control. The positions arise in a progressive company in the London area and they are permanent and pensionable.—Write, with full particulars and reference ACJ, to Box 3715. [9898]

WEIGHTS engineer required to take charge of weights department, also senior assistant, for work on fixed wing and helicopter aircraft. Good welfare facilities, including staff pension scheme.—Applications, in writing, to Technical Director, Percival Aircraft, Ltd., Luton Airport, Beds, giving details of age, training, qualifications, experience and salary required. [9892]

TEST laboratory assistants (male) required by Percival Aircraft, Ltd., Luton Airport, Beds. National Certificate standard and previous experience on design of test laboratory equipment desirable. Good welfare facilities including staff pension scheme.—Applications, stating qualifications, experience, age and salary required, to Personnel Manager. [9908]

REQUIRED immediately by Percival Aircraft, Ltd., Luton Airport, Beds, several draughtsmen with comprehensive experience of engine installations and allied systems. Good welfare facilities, including staff pension scheme.—Applications, in writing, stating age, qualifications, experience and salary required, to the Personnel Manager. [9901]

APPLICATIONS are invited from senior and intermediate design draughtsmen. Experience of aero-engine design desirable, but not essential. Also checkers. —Please write, stating age and giving details of previous experience in chronological order to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [9930]

INTERMEDIATE mechanical and structures draughtsmen required. Possibility married accommodation adjacent airfield later. Chesil fast transport Bournemouth and Poole areas.—Reply, giving details of age, qualifications, experience and salary expected, to Personnel Manager, Flight Refuelling, Ltd, Tarrant Rushton Airfield, Nr. Blandford, Dorset. [9970]

NEW ZEALAND NATIONAL AIRWAYS require instrument repairers and radar mechanics. Preference will be given to applicants holding the appropriate licences. Only single men wishing to emigrate to New Zealand should apply. Free passage provided; accommodation arranged on arrival.—Applications, clearly marked "New Zealand National Airways," giving full details of training, experience and qualifications, should be sent to the Chief Personnel Officer, British Overseas Airways Corporation, Airways House, Great West Road, Brentford, Middlesex. [9977]

SITUATIONS VACANT

A VARIETY of posts for junior and senior technical assistants have to be filled in an expanding company in the London area which is engaged on aero gas-turbine research and development. Stressmen, development and performance engineers and compressor, turbine and engine testers are invited to apply. H.N.C. or degree preferred.—Write, with full details, quoting reference HIC, to Box 3719. [9911]

CHIEF technical clerk required for the gas turbine department by large firm in the East Midlands, to take charge of drawing-office records and be responsible for routine correspondence, and issuing drawings and works instructions for manufacture. Knowledge of works and drawing-office procedure essential. Excellent opportunities for initiative.—Applications, stating age, qualifications and experience, to Box 4007. [9905]

APPLICATIONS are invited from design draughtsmen and stressmen, also technical assistants with considerable design and performance experience for work on both reciprocating and gas turbine aero-engines.—Applications should state full particulars of experience and qualifications and should be addressed to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [9932]

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BRITISH OVERSEAS AIRWAYS CORPORATION have vacancies for pilots below the age of 27. Minimum qualifications include commercial pilot's licence with instrument rating and radio telephony licence. Commencing salary dependent on qualifications—£315 per annum to £705 per annum.—Application should be made in writing to the Chief Personnel Officer, B.O.A.C. Airways House, Great West Road, Brentford, Middx. [9944]

TECHNICAL sales representative (age 30-40 years) required by aircraf. accessory manufacturers situated 25 miles London. Applicants must possess sound knowledge of the aircraft industry, have had experience in a similar position, and have own car. Salary £575-£625, plus expenses. Superannuation scheme. Five-day week.—Write in first instance, giving details of past experience. All replies treated in confidence. Box [illegible]. [9981]

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FLIGHT simulator pilot instructor required by British Overseas Airways Corporation at their Central Training Unit, near London Airport, to give basic and applied four-engined instrument instruction. Following qualifications or equivalent required: (a) good flying experience as pilot on modern four-engined aircraft; (b) considerable experience as flying instructor; (c) a capacity for application. Salary range, £760 to £1,000, depending on qualifications and experience.—Applications to Staff Superintendent (Recruitment), B.O.A.C., London Airport, Hounslow, Middx. [9975]

FLIGHT simulator engineer instructor required by British Overseas Airways Corporation at their Central Training Unit, near London Airport, for operation of engineer's panel of flight simulator and giving instructions as necessary. Following essential qualifications required: (a) good technical knowledge of operating characteristics and functioning of aircraft, engines and systems applicable to modern commercial aircraft; (b) sufficient basic knowledge of electronics to be able to acquire working knowledge of simulator; (c) at least five years' aircraft engineering experience; (d) previous experience as an instructor. Salary range, £595 to £760 per annum, depending on qualifications and experience.—Applications to Staff Superintendent (Recruitment), B.O.A.C., London Airport, Hounslow, Middx. [9976]

BRITISH OVERSEAS AIRWAYS CORPORATION have vacancies for engineer officers (Flight Engineers). Applicants must be between 21 and 35 years of age, of a high standard of physical fitness, and educated to matriculation or equivalent standard. A strong flying background and training is essential, and only those with Maintenance Engineer's Licence endorsed in Categories "A" and "C" (preferably on more than one engined aircraft) will be considered. Successful applicants will be appointed for a probationary period while undergoing training. Salary for qualified men commences at £725 per annum, rising to a maximum of £1,295 per annum, plus certain allowances payable whilst on service.—Application should be addressed to Chief Personnel Officer, B.O.A.C., Airways House, Great West Road, Brentford, Middx. [9979]

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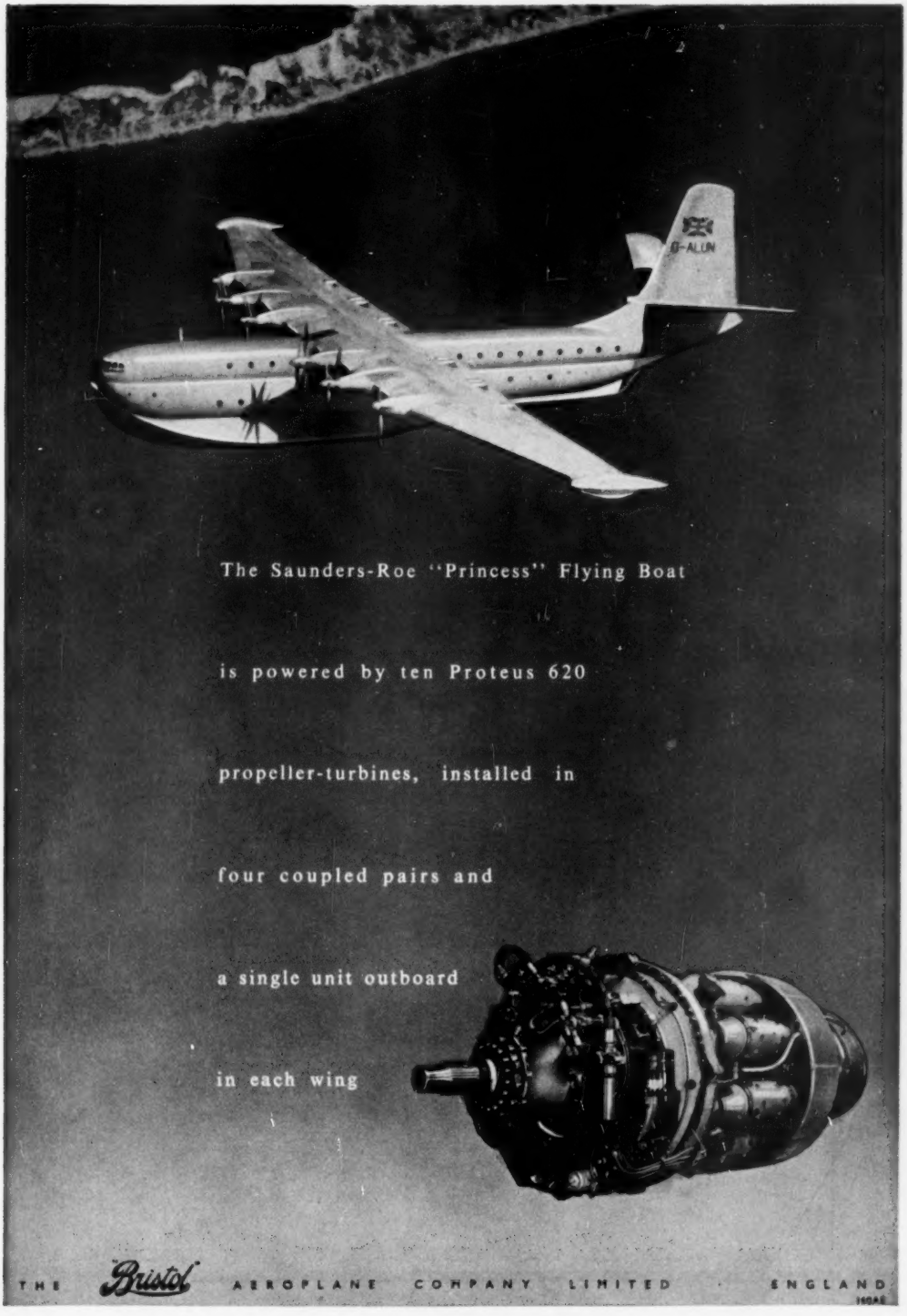
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